AUGUST 29, 1936

ELECTRICAL WORLD

SEP 1 1936

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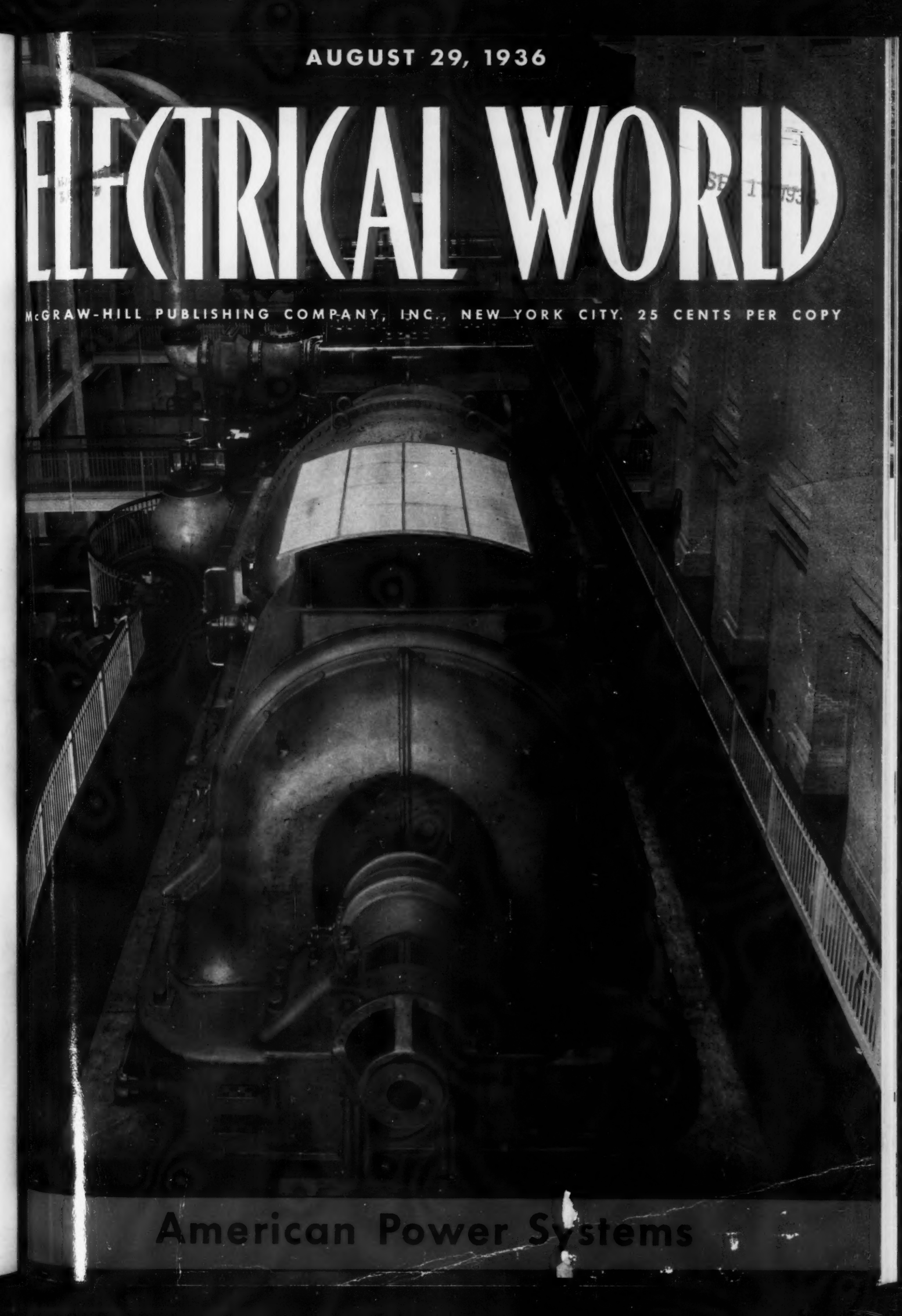

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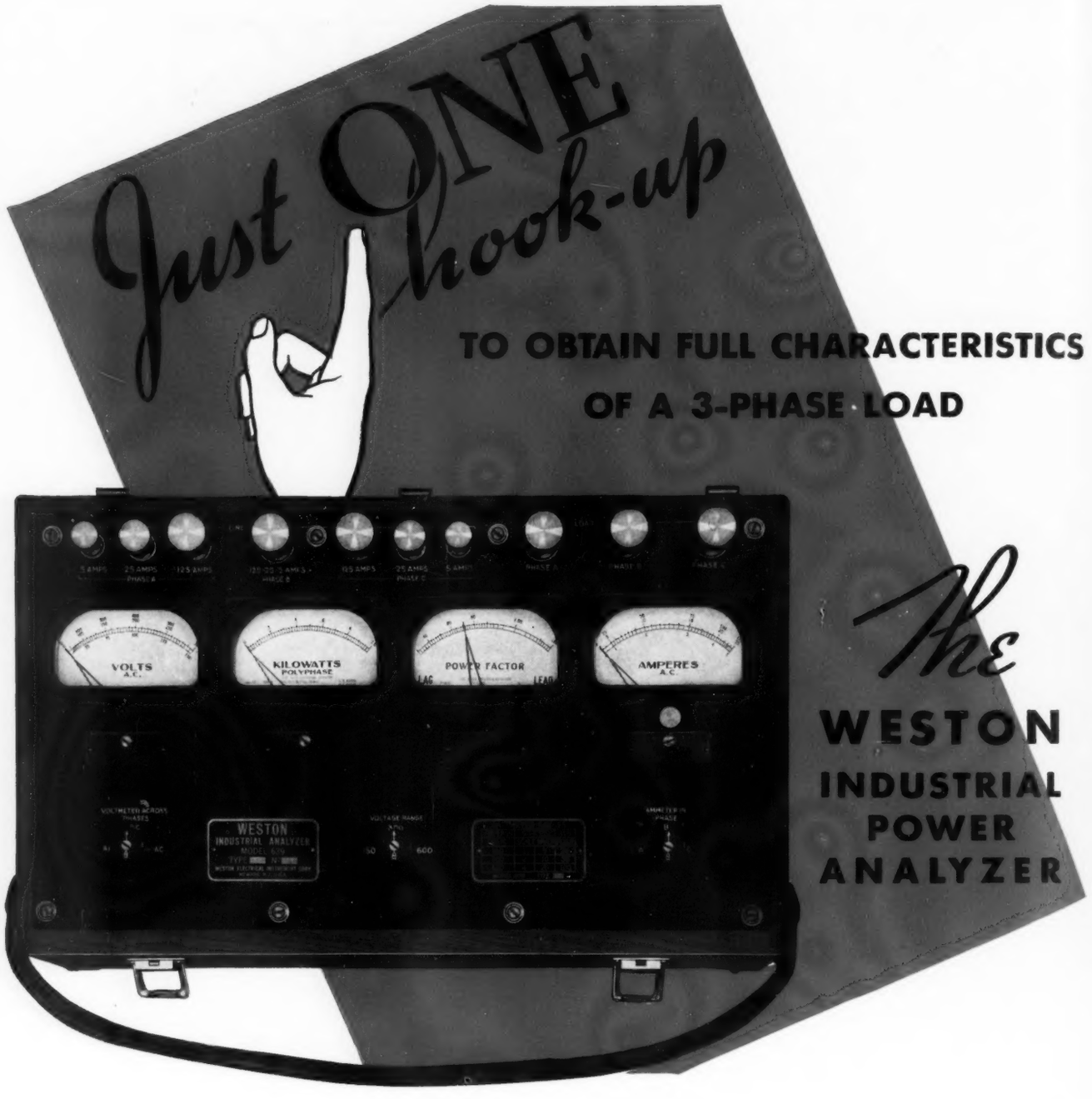

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Coming Features

Appliance Survey

Complete statistical details of appliance sales by 132 utilities for the first six months of 1936 will be published as a feature of ELECTRICAL WORLD for September 12. These data tell a story of appliance sales in unprecedented magnitude.

World Power Conference

Some 3,000 experts on power supply will be in Washington at the World Power Conference September 7-12. This meeting will be reported in ELECTRICAL WORLD for September 12. An international event of great significance.

Special Articles to Come

Electrical Equipment Used in Building Construction
New Superposed Unit for Fisk Street Station
Heat Treating Airplane Parts
Treating Standing Poles
Modernizing Switchyards

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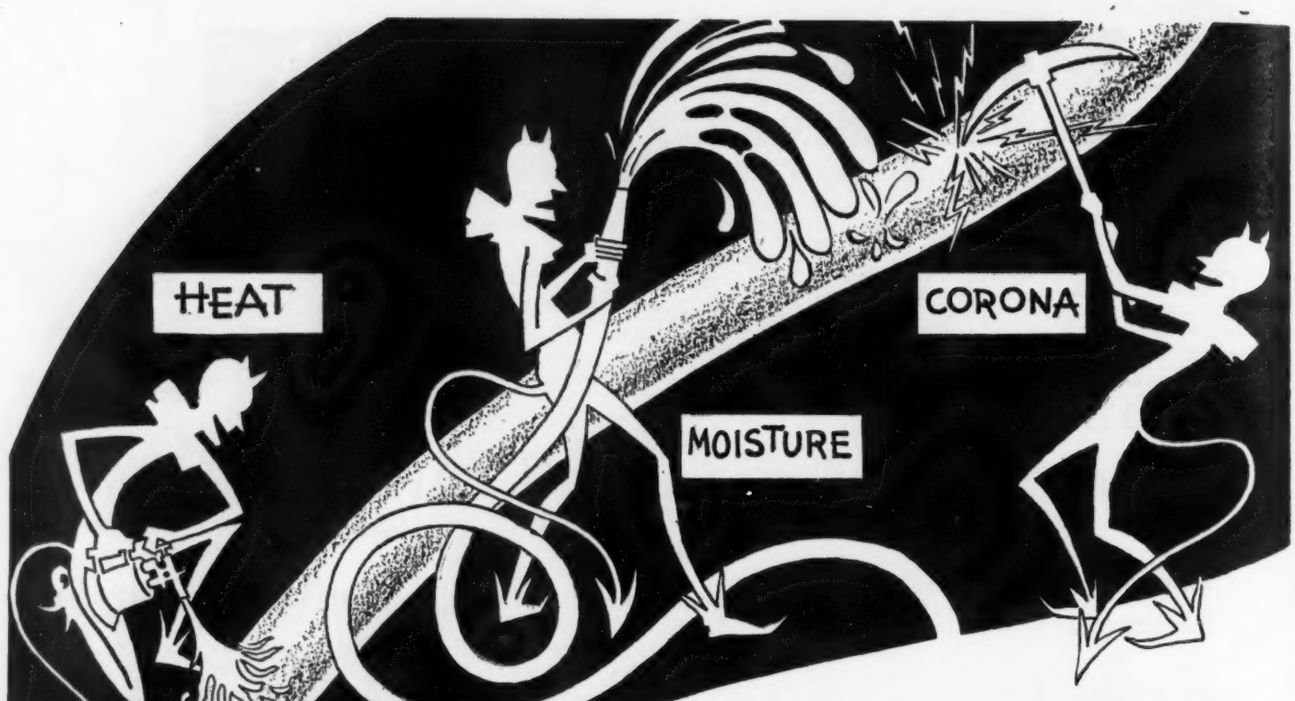

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Letters TO THE EDITOR

Electric Fence on 7,000 Farms

To the Editor of ELECTRICAL WORLD:

In your February 22 issue, on page 8, a very interesting comment was noted relative to the electric fence for the turning of livestock. In view of the interest that this article displays as viewed in the comments in the May 9 issue, we thought you would be interested in some first-hand information on the original electric fence unit that has been on the market for some four years. It is now in operation on more than 7,000 farms in this country.

The electric fence, if it is properly and safely controlled by the Prime controller, can and does turn any type of livestock, including large 2,000-lb. herd sires down to the smallest pig. We now have developed a unit that has a maximum output of current which is far below the minimum amount of current which authorities determined as the danger point. The Prime controller contains a patented chopper which cuts the current on and off at three-second intervals. This, in turn, sends the intermittent current out over the one-wire fence, not only for the reason of preventing the possibility of giving an animal a continuous shock but also because sharp stings at intervals will surprise an animal touching the wire more so than a steady flow of current that might be on the wire.

The Prime controller contains a dry and normal weather switch, so that wherever the ground becomes extremely dry the farmer throws the switch to the dry side, which in turn increases the voltage and decreases the amperage delivered.

C. P. Fox
Prime Manufacturing Co.
Milwaukee, Wis.

•

Switch Shunt Capacitors for Voltage Regulation

To the Editor of ELECTRICAL WORLD:

A number of articles have appeared recently in regard to the use of series capacitors in distribution circuits for improving voltage conditions, but in each installation of series capacitors it is necessary to have a reasonably well-regulated supply voltage in order to obtain best results from the series capacitor installation.

Step-voltage boosters have come to the front during the past few months and these devices are assisting greatly in the regulation of voltage in addition to induction regulators, regulating transformers and tap-changing-under-load transformers.

There appears to be one additional method of obtaining better voltage regulation, other than has been given above, that has not received its just share of publicity. The standard parallel capacitor together with automatic switching should be given more consideration. Two or more automatic steps could be used and the voltage on any distribution system fed through a transmission line could be raised when necessary by switching in additional capacitor units and could be lowered as needed by cutting out capacitor units.

Switching in and out capacitor units might seem a little complicated, but it will not be more complicated than voltage booster or regulating transformer switching equipment with the same number of steps.

The industry will be making another forward stride when quantity production is applied to parallel capacitor installations with automatic switching on distribution circuits for maintaining proper voltage levels and at the same time securing the advantages of reduced flow of wattless current throughout the entire system.

WALTER C. HERBERT,
Rural Engineer Elec. Util. Dir.
Public Service Commission,
Columbia, S. C.

•

Revised Data on Shawinigan Power

To the Editor of ELECTRICAL WORLD:

We have a copy of the Supplement to ELECTRICAL WORLD, May 9, 1936, giving data on peak load and output of largest generating and distribution systems in North America. We find that the figures for the Shawinigan Water & Power Company have not been reported to you upon the same basis each year, and for your records and for a possible future issue of a similar supplement we submit to you the attached figures. The 1935 total output kilowatt-hours as reported to you did not include a block of 460,450,901 kw.-hr. of purchased energy. The corrected figure for the total output, including all purchased energy for 1935, should be 5,253,362,457 kw.-hr.

J. MORSE,
General Superintendent
Shawinigan Water & Power Co.
Montreal, Canada

[The tables accompanying this letter call for a change in Table I (Suppl.) of system peak load for 1928 to 467,800 kw. and elimination of figures for station peaks prior to 1935. Output, including purchased energy, is revised as follows:

1935	5,253,362,457	1931	3,247,397,711
1934	4,536,013,743	1930	3,226,014,549
1933	3,842,872,196	1929	3,418,541,758
1932	3,170,358,660	1928	2,948,671,790

In Table II sales to electric boilers becomes 2,219,579,308; used by company 21,060,603; losses 427,413,585.

Generated kw.-hr. becomes 3,711,956,260 and purchased 1,541,406,197, total 5,253,362,457.—EDITORS.]

Carrier "Tailors" Water Heater Load on Feeders

To the Editor of ELECTRICAL WORLD:

The growing importance of domestic load accentuates the problem of off-peak control and urges correct understanding of the different methods. Now and then we find mistaken impressions among operating men about carrier current, especially with reference to its flexibility.

With modern carrier-current equipment a substation operator can control water heaters on each feeder without affecting the heaters on other feeders leaving the same substation bus. These water heaters can be controlled at any time in accordance with any condition with which this load is to be co-ordinated.

The most usual method is to switch the water heaters off an individual feeder when the feeder load reaches a predetermined maximum, then switch them on again when the load on that individual feeder has dropped to a predetermined value. This keeps down the peak load on every feeder, and therefore on distribution transformers, primaries, secondaries, and the substation as a whole, as well as on generation and transmission.

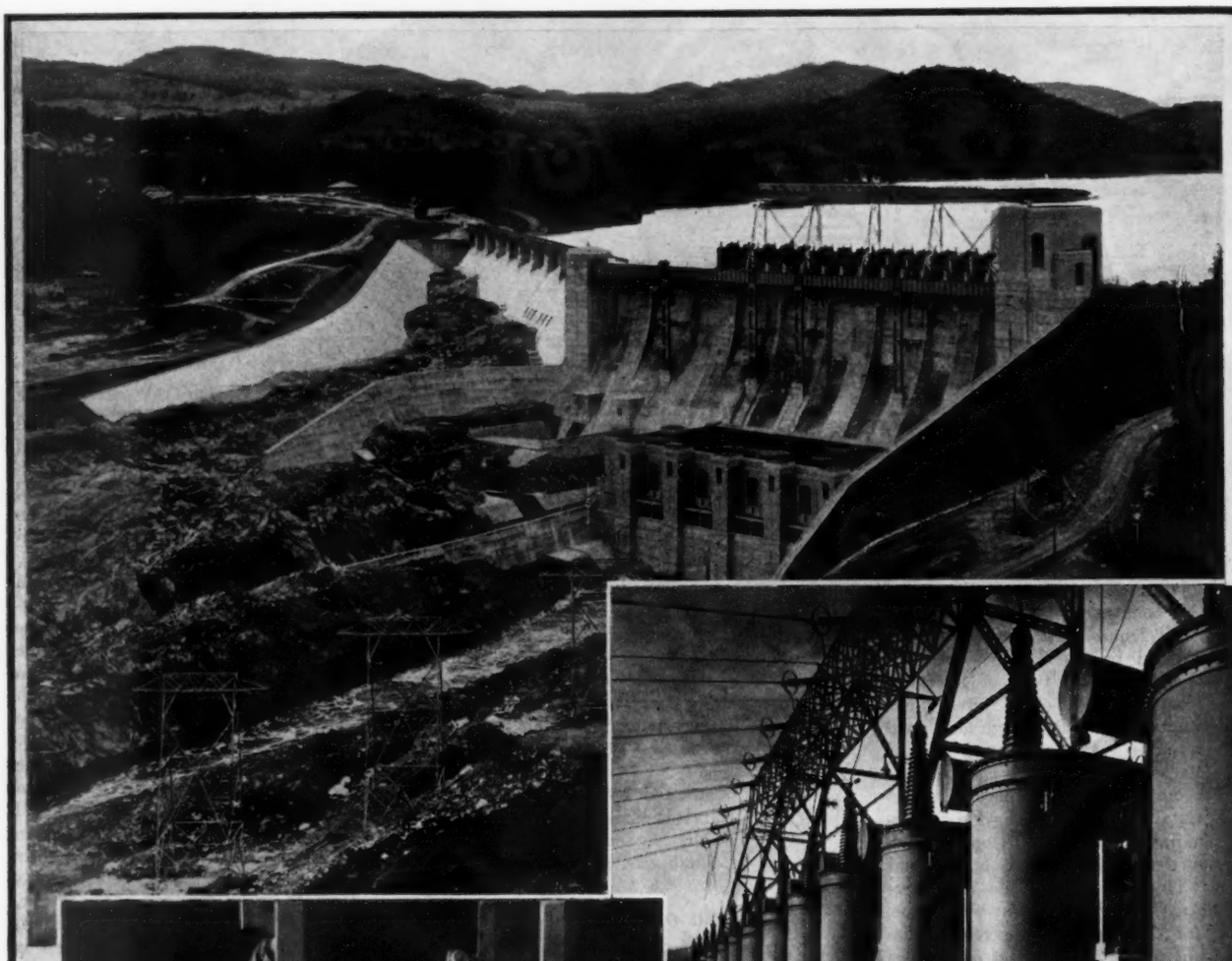
Users agree that individual feeder load is the best available day-to-day indication of the variation in loading of the distribution transformers and secondaries connected to that feeder.

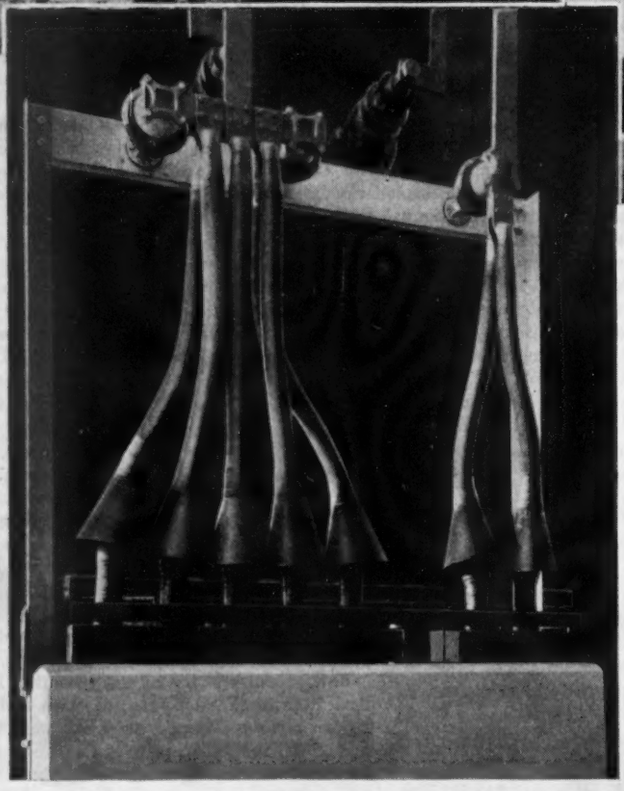
Where it is deemed desirable to avoid bringing all water heaters on a feeder simultaneously, the operator can vary the carrier voltage being impressed on the feeder and send out successive "on" impulses, which will progressively pick up portions of the water-heater load on that feeder. Likewise, he can cut off heaters gradually in the same way.

In addition to this step-by-step control, and in addition to individual feeder control, carrier offers an even further refinement through the use of two different frequencies. However, on most systems such refinement is not required and seems to have very little appeal to the great majority of prospective users, because individual feeder control goes about as far as practical considerations permit.

Carrier current for off-peak control is so flexible in application and operation and can be so closely adapted to local conditions that it is like tailoring a suit. It is necessary only that the requirements be measured to assure to the user all of the many real economies which this form of direct control offers.

T. JOHNSON, JR.
Carrier-Current Section,
General Electric Company,
Schenectady, N. Y.





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ELECTRICAL WORLD

AUGUST 29, 1936

National Power Supply

Social and economic well-being for a nation is proportional to its use of power. This old claim has new significance these days because it is accepted and acted upon by the political authorities of each country. Heretofore, it was an engineering conception; now it is a political program.

This fact is evident from a study of the papers to be presented at the World Power Conference in Washington. They are permeated with the political acceptance of the social value of power supply and of the social necessity for the conservation and utilization of natural resources. The political plan for each nation is tied definitely to national power economy. Somebody has sold a splendid idea.

For no one would wish to dissipate the political fervor for an abundant use of power. The idea is too sound and the agency too effective. But there is a chance that the politicians will go wrong in carrying out their plans in any country. The economics and engineering of power supply may be violated, and thus the failure of an ill-conceived program may cause the politicians to desert a good cause.

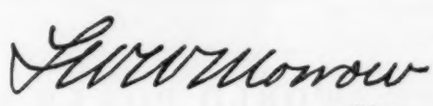
This is where engineers and power experts come into the situation to give guidance. And, speaking quite frankly, they have neglected to do this in this country and in other countries in an effective manner. The proof lies in the basically false assumptions that the politicians accept as facts in their endeavor to build a national power supply.

One of these is the idea that the best power supply is a national grid of high-voltage lines supplied by large hydro and steam plants. Especial emphasis is put on large hydro plants and long-distance power transmission. This is a beautiful conception, but it violates economic and service facts and is against the evident trends.

Yet several nations have gone ahead on this line. As will be brought out at the conference, already one or two find that such a plan is noncompetitive with local power generation at load centers. What, then, did the politicians do? They taxed these local plants and prevented any more of them from being built. The political authorities were forced by political reasons to support a false economic structure. This is the fault of engineers and not of politicians.

There are many other economic and technical facts about power supply that have not been told to the political authorities who are trying to build a national power supply. These men will welcome the facts. They are sound in their basic idea and sincere in their program. It is an indictment of engineers and power experts if they go wrong. The facts about power do not directly involve the policy of public or private ownership. They fix the type of power supply structure to build toward; the facilities, the technical principles, the economics of power supply, the direction of technological and economic trends.

No occasion or setting equal to this World Power Conference at Washington can be imagined to bring out the facts about power supply and to use them. It is to be hoped that every international expert on power will speak out. This is no occasion to make defensive discussions about existing systems. It is an opportunity to get an international program for power supply launched on a tangible basis and in accord with economic and service facts. We hope American power experts will take leadership in this opportune meeting. They know, if they will only speak.



Editor

Wide World

SEPTEMBER 7-12

WORLD POWER EXPERTS MEET IN WASHINGTON

Trends in Power Supply

Economic Facts Dictate Use of Multiple Generating Plants Located at the Load — Fallacies in Use of Hydro and Transmission Lines Evident — Typical Examples of Recent Station Designs — Data on Power

By L. W. W. MORROW
Editor ELECTRICAL WORLD

ELECTRIC power is being used in this country in ever-increasing amounts, and yet no one can point to any degree of saturation. It is so indispensable to American life and business and there are so many new uses and new devices to use power produced each year that no apparent limit to its use is in sight.

The present power capacity amounts to 51,100,000 kw., of which 36,100,000 kw. is in utility plants and 15,000,000 kw. in industrial establishments. Of this total capacity hydro makes up 11,100,000 kw. and fuel-burning stations 40,000,000 kw. During the past ten years the increase in power capacity has been made almost entirely in utility plants. This trend continues.

Most of this capacity is new and fairly economical. It is built at the loads and in accord with economic facts. Yet at this time nearly 2,000,000 kw. of hydro power is being built by the federal government and this is located at a distance from loads and in regions where industrial activity and population density are low. The assumption is that industry will go to the power and that hydro power is cheap power.

Of course industrial plants figure on the cost of power, but they find this cost about the same in all regions. The major considerations with them are the market situation and labor rates and conditions. Power, taxes, raw materials and other factors are of secondary importance. Some few industries that have power as the dominant cost element in production may avail themselves of these new developments.

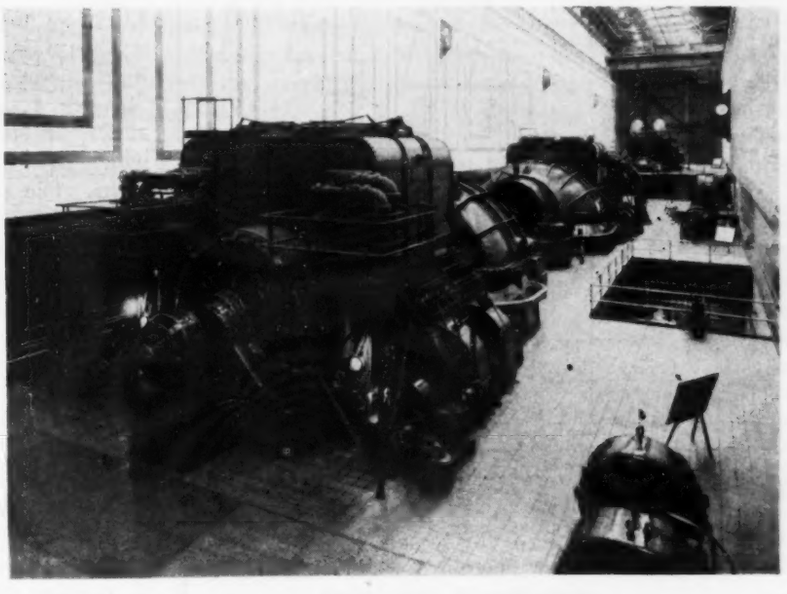
Up to this time American power supply has been built by integrating fuel and low-cost hydro plants in industrial areas through the use of interconnected transmission lines. The general practice was to use large units, large stations and high-voltage transmission lines. As a consequence what might be called the base generating and transmitting structure has been built.

Now the problem is one of intensifying the loading on the existing structure and of adding capacity and reducing costs. A study of the economic facts shows that as a general principle power is best and cheapest when generated at the load. Also, it is cheaper in general to transport coal by rail than it is electric power by transmission lines. Consequently the general trend is toward the use of multiple, rather small, generating plants located at the loads. This trend is accentuated by the increasing use of steam for heating and processing in industrial plants. Under these conditions transmission is an economic means to utilize diversity and to reduce reserve margins rather than a delivery system for firm power over long distances.

Status of fuel plants

Fuel-burning stations can now be built for about $85 per kilowatt to operate at about 12,000 B.t.u. per kilowatt-hour and to give a busbar cost of power at usual load factors of from 3.5 to 4 mills per net kilowatt-hour. This is good practice, but it is not the best record available. Most of the capacity now in operation required an investment of about $100 per kilowatt and operates on from 16,000 to 18,000 B.t.u. per net kilowatt-hour, giving a power cost at busbars of from 6 to 7 mills per kilowatt-hour.

With the best stations having a thermal efficiency of only about 30 per cent, it is obvious that leeway exists to get better performance. But with the present prices of fuel very little additional money can be spent to attain high thermal efficiency. Better pros-



Interior view East River station, New York Edison Company

pects for cost reduction lie in getting a more logical and economical commercial set-up whereby a power plant is designed, purchased and built as a unit, thus eliminating space, extra material, detail engineering and sales costs and many commercial expenses.

Promising fields of exploration lie in the use of the mercury-steam cycle, but as yet these attempts are not generally economical.

A third possibility, especially for plants now operating under 400 lb. pressure, is to add needed capacity to existing stations by superimposing a high-pressure unit on existing low-pressure plants. This is being done in many instances at this time.

Still another evident trend is to locate needed capacity in or near industrial plants that use steam as well as power. This makes for an economical arrangement for both the utility and the industrial.

It appears probable that unit steam plants can be built in the near future at a cost of from $60 to $70 per kilowatt to operate at about 11,500 B.t.u. per kilowatt-hour in relatively small sizes; *i.e.*, from 20,000 to 100,000 kilowatt units. Larger units do not appear economical when load conditions, service conditions and all transmission costs are considered.

Most of the low-cost hydro sites in market areas have been developed. An average price for the federal projects now under way is about $250 per kilowatt of firm power, and at 10 per cent charges and cutomary load factors this gives a busbar power cost total of about 6 mills per kilowatt-hour. This price does compete with a fuel plant under favorable conditions. If there is secondary power on these projects it is usable only if steam reserves are installed or if used in an interconnected system. Very careful studies are necessary to fix upon an economic way to use these new high-cost hydro developments. Possibly charging off much of the investment to flood control and navigation is one way out of the difficulty.

Status of transmission

It costs about 2 mills per kilowatt-hour per 100 miles to send power over 132-kv. systems if line and terminal substations are considered. A comparable figure for a 200-mile, 220-kv. line and substations is 2.5 mills per kilowatt-hour. These costs are in addition to generating plant costs.

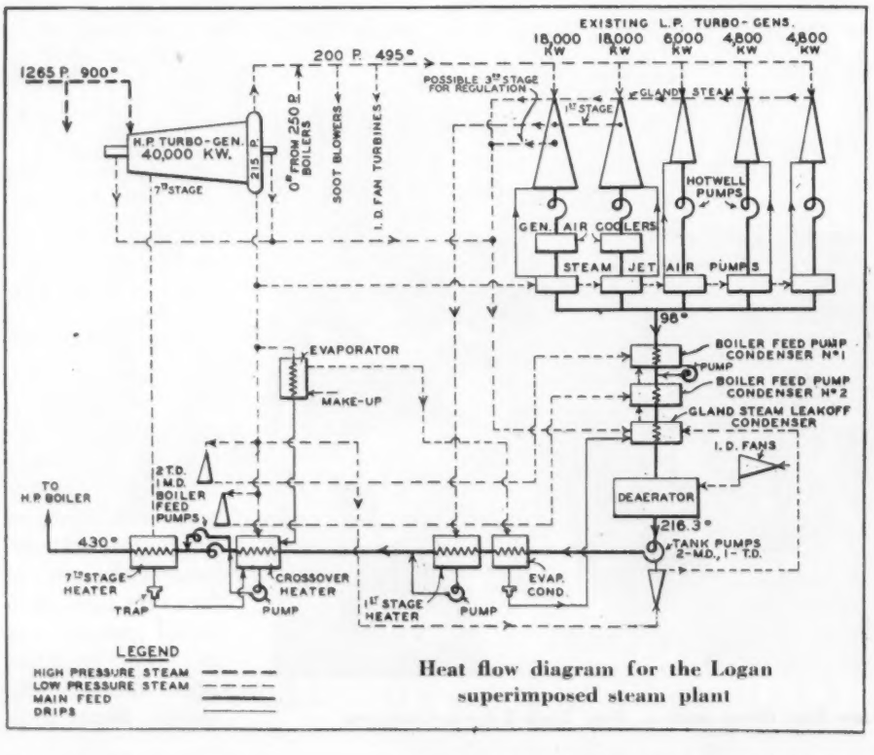
With normal coal and transportation costs coal can be transported 100 miles for about ¾ mill per kilowatt-hour equivalent and 200 miles for slightly less than 1 mill. *Thus it costs about 2.5 times as much to transmit electricity as it does to transport coal under average conditions.* To make transmission economical, therefore, there must be an appreciable difference between the generating cost at the load and the cost of generation at a distance from the load. This condition is exceptional in any developed areas of this country today.

Because of service needs and of economic facts it is apparent that our power supply is tending more and more toward decentralization or local generation, with stress on the development of more economical fuel-burning plants. The idea of the superpower station and long-distance, high-voltage transmission line is an economic and service fallacy.

It is apparent that present additions to capacity will come from modernizing older plants and from adding relatively small generating plants to existing systems. There is little in the offing to warrant any positive change in this picture in the near future.

Examples of recent plants

To give an idea of what is going on in present power supply economics a few examples are given of recently built new plants or addition to old plants. The basic ideas only are presented as illustrated in these plants. Most of them have been described in detail already or are in the construction stage only. These samples represent the art as of today and point toward the future.



Heat flow diagram for the Logan superimposed steam plant

Logan Uses Hydrogen-Cooled Unit

A 50,000-kva., 3,600-r.p.m. hydrogen-cooled generating unit to operate at 1,250-lb. pressure is an innovation installed as a superimposed unit in the Logan station of the American Gas & Electric Company.

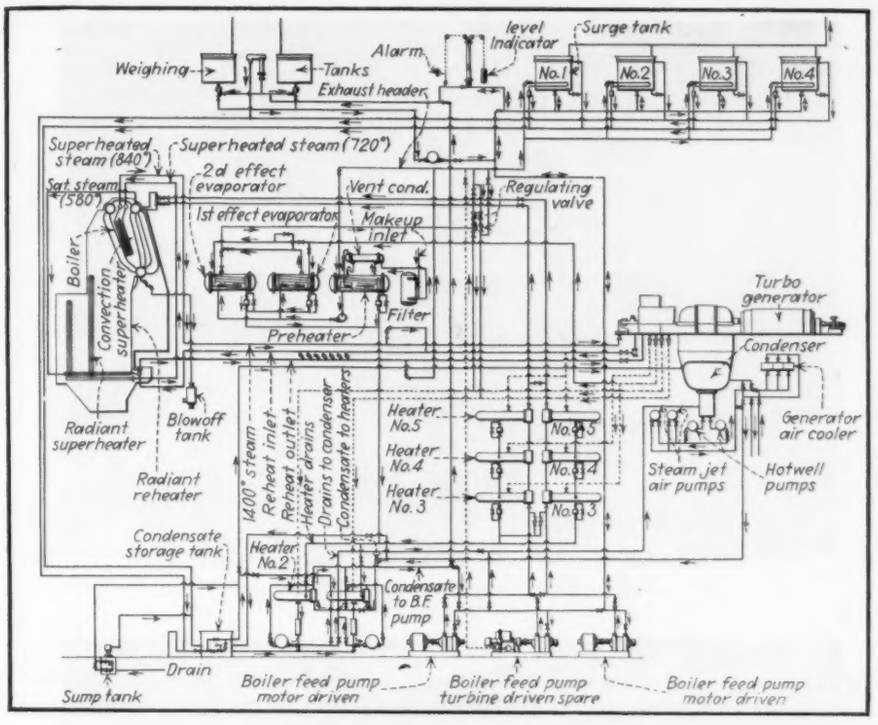
This plant now has two 20,000-kva. units operating at 260 lb. pressure and 580 deg. F. and two 5,000-kva. units at 200 lb. pressure and 480 deg. F. which have not been operated for six years. The first-stage nozzles on the 20,000 units will be replaced to get the increased steam flow from the high-pressure unit and the new unit will exhaust at 200 lb. into the four existing low-pressure units and a 6,000-kw. unit which will be moved to the Logan plant. A new 1,000,000-lb., high-pressure boiler will give steam for the entire station. The new station will have a high-pressure capacity of 44,500 kw. and a low-pressure capacity of 51,600 kw.

A single cross-over pressure of 200 lb. supplies the five low-pressure units, the fan turbines, boiler feed pumps,

steam jet air pumps, evaporator and cross-over heater. This cycle is expected to give a heat reduction from 23,000 B.t.u. to 12,000 B.t.u. per kilowatt-hour output of the station.

The turbine will have an inner and outer casing with exhaust steam at 200 lb. surrounding the inner casing. The unit will have eleven stages with seventh stage bleeding. The stator will be water cooled. The armature will be cooled by hydrogen gas which is cooled by passing over water-cooled fins. Use of hydrogen cooling reduces windage losses 450 kw. Governing will center on the maintenance of a fixed back pressure under the control of a pressure regulator so that the high-pressure turbine will follow low-pressure unit loadings.

The boiler is designed for 1,325 lb. at 925 degrees. It is a six-drum, V-type unit using tangent tube construction for the water walls, tangential firing and dry bottom. Superheaters are of the convection type, vertically supported. Return bent tube economizers are used.



Flow diagram for Port Washington plant
Less than one-half of 1 per cent of water is lost in the circulating cycle

Semi-Outdoor Steam Plant

Outdoor types of hydro plants are accepted and an appreciable trend is found to build at least semi-outdoor steam plants. A saving of from 1 to 2 per cent in investment cost is said to be made. One of the latest designs is the Provo station of the Utah Power & Light Company in Utah. It is a unit type 18,750-kw., semi-housed plant. The boiler is housed on all sides for the first 20 ft. of its height and the remaining 35 ft. is outdoors, but suitably protected from the elements. Water columns and feedwater regulators are housed and twin induced-draft fans are housed in the Venturi stack base, but driven by outdoor motors. A three-drum, bent-tube boiler of 200,000 lb. per hour is fired by a traveling-grate stoker. The turbine is 3,600 r.p.m. for 400-lb., 750-deg. steam conditions.

Below the turbine is a 23-ft. high basement 50 x 75 ft., in which is housed condenser, heaters, evaporators, pumps and other equipment. Hatches are provided through which turbine, generator and other parts are handled by a 25-ton gantry crane. Station auxiliary and main transformers are outdoors. The plant is designed to operate at about 15,500 B.t.u. per net kilowatt-hour with a regenerative cycle having three-point bleeding. Only one forced draft fan, one circulating pump, one condensate pump and a single-bank, steam-jet air pump are used, and all motors are constant speed.

Performance of Port Washington Station

Month	Plant Output Kw.-Hr.	Load Factor, Per Cent	B.t.u. per Net Kw.-Hr.	B.t.u. per Lb. of Coal Consumed
October, 1935	2,921,400	14.08	16,315	13,132
November, 1935	3,601,300	8.87	13,373	13,347
December, 1935	31,884,000	72.22	11,639	13,163
January, 1936	34,332,071	76.24	11,336	12,976
February, 1936	34,023,498	62.97	11,255	12,878
March, 1936	23,488,326	53.94	11,444	12,825
April, 1936	30,537,658	72.43	10,946	13,130
May, 1936	26,460,282	60.8	11,029	13,271
June, 1936	26,519,490	61.8	10,965	13,384

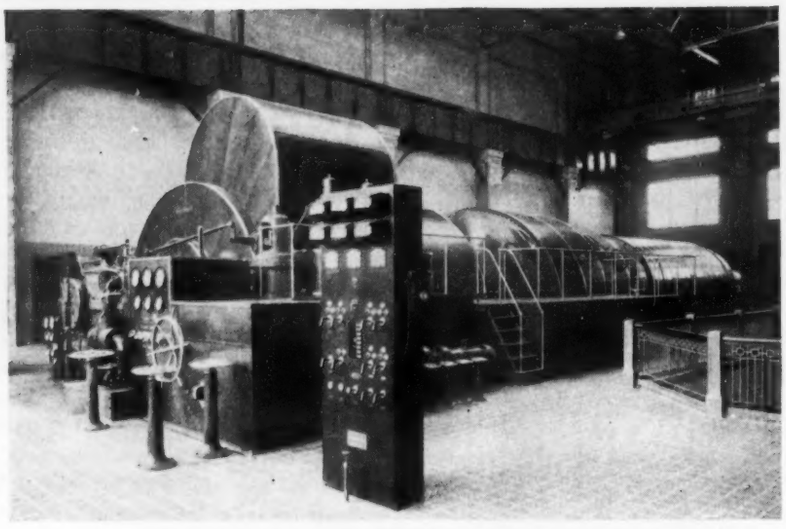
The power plant month used in computing the above figures ends five days previous to the end of the calendar month. The plant was cut in for the first time on October 14, 1935, and after October was not cut in again until November 22, after which it remained in service continuously until March 14, 1936, a period of almost four months.

World's Best Station

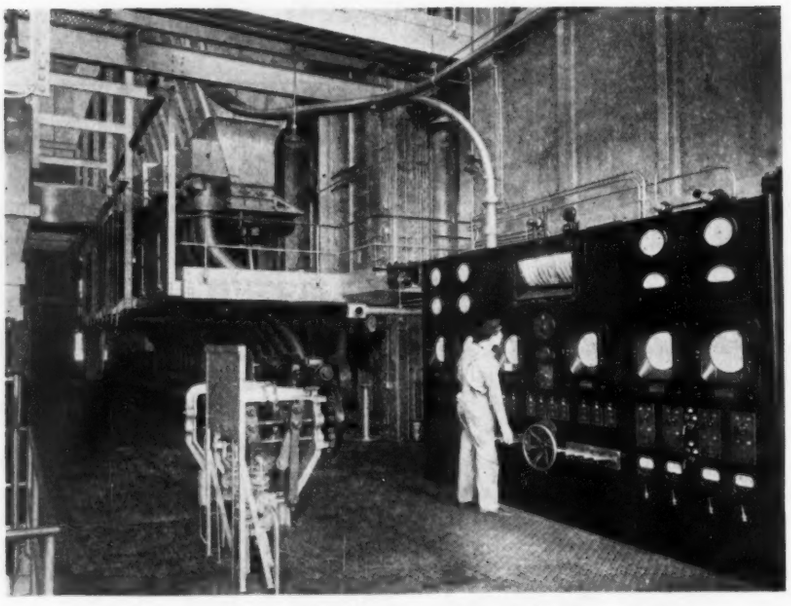
The Port Washington plant of the Milwaukee Electric Railway & Light Company was completed in November, 1935. Since going into operation it has averaged 11,320 B.t.u. per kilowatt-hour, with a performance in April, 1936, of 10,946 B.t.u. per net kilowatt-hour.

This unit type 80,000-kw. station represents the latest practice in American power plants. The salient features of the plant are the use of a 690,000-lb.-per-hour unit boiler at 1,320 lb. operating pressure, 835-deg. steam temperature with an 80,000-kw., 22,000-volt generator. The three-drum, bent-tube boiler is 44,087 sq.ft. with a convection superheater of 8,700 sq.ft. and a radiant superheater of 1,464 sq.ft. A 1,420-sq.ft. reheater is used and a 121,000-sq.ft. air heater. A bin and feeder pulverized fuel system supplies the furnace. This has 58,000 cu.ft. above water screen, 14,000 cu.ft. below water screen with 7,976 sq.ft. of water walls. About 15,000 B.t.u. is released per cubic foot of furnace volume per hour and the approximate mean furnace temperature is 2,100 deg.

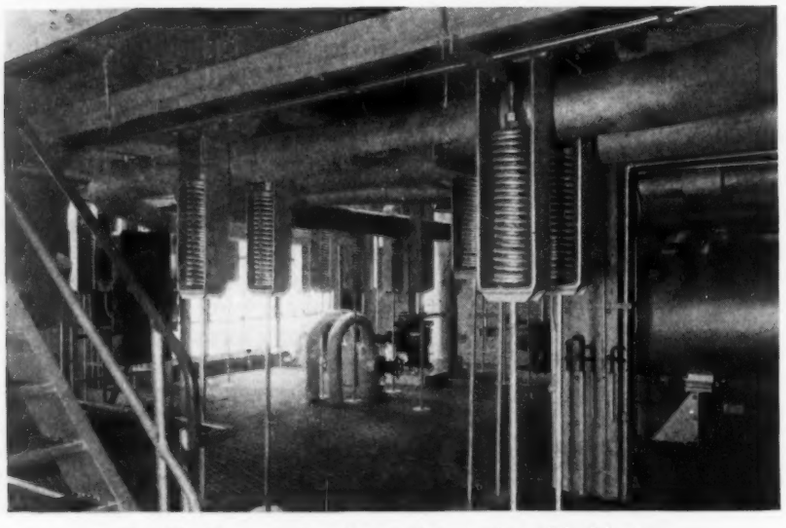
Radiant superheater and reheater surfaces are used for side and rear walls, water tubes for front wall and



Interior view of Port Washington turbine room



Boiler room operating deck in Port Washington station



Flexible hangers for steam pipes in Port Washington

an ash screen. Five stages of feedwater heating are employed, with feed pumps between the second and third extraction points.

The 80,000-kw. tandem-compound turbine unit operates at 1,800 r.p.m. at 1,230 lb. and 825 deg. Reheated steam at 825 deg. is admitted to the turbine half way through the high-pressure section. The generator rating is at 85 per cent power factor. Excitation is provided by a 300-kw. direct-connected exciter and a 5-kw. direct-connected pilot exciter. A reserve 250-volt excitation bus is provided.

Generator neutral is grounded through an 8-ohm resistor. The air-cooler can use either raw water or condensate and the cooling air is circulated by two 200-hp. fans. The main bus is 22,000 volts with vertical phase isolation in the switch house. A fault bus system is installed. Outgoing 22-kv. feeders have 3 per cent reactors and the 22-kv. and 132-kv. breakers have an interrupting capacity of 1,500,000 kva.

The station auxiliary system is all electrically driven except one boiler feed pump and one house service pump, which are steam driven under emergencies. Motors above 100 hp. are 2,300 volts and those smaller are 460 volts. Auxiliary load is carried in a three-winding transformer in generator leads, but a spare transformer is connected to the 22-kv. bus.

165,000-Kw. Unit in Richmond

An interesting problem in station design was solved by engineers of the Philadelphia Electric Company in installing a 165,000-kw. turbo-generator unit in Richmond station during 1935. This unit was put in a space reserved for only a 50,000-kw. unit.

The turbine is a tandem-compound unit operating at 400 lb. and 850 deg. with four-stage bleeding. The high-pressure cylinder is a single-flow, straight-reaction type and the low-pressure is a double-flow unit. The governor valves are operated by a non-inflammable fluid which is supplied by a hydraulic turbine operated by the bearing oil.

A 113,000-sq.ft. single-pass condenser is located below the turbine with a 20,000-gal. hotwell in the condenser pit. Two circulating water pumps of the vertical propeller type with a combined capacity of 115,000

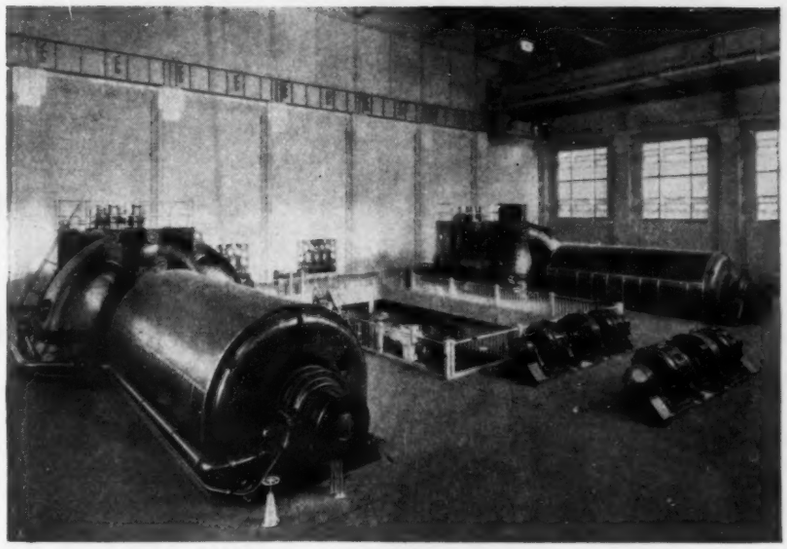
g.p.m. are used. These are driven by 2,300-volt, 500-hp. vertical squirrel-cage motors. Two steam jet air pumps are provided for each of three two-stage ejectors.

Two pulverized fuel boilers, cross-drum, are used. They are designed for 600,000 lb. of steam per hour at 425 lb. and 850 deg. An interdeck superheater maintains a final temperature of 850 deg. Two air heaters are provided with each boiler. One condensate pump and three boiler feed pumps are electrically driven.

The pulverized fuel system is of the bin type, with two mills, two exhausters, two feeder blowers, eight burners and one coal bin for each boiler. Boiler feed pumps are constant speed with 800-hp., 1,800-r.p.m. squirrel-cage motors. Condensate pumps are variable speed by means of hydraulic couplings with 700-hp., 1,200-r.p.m. squirrel-cage motors. The mills are of the ball type of 20 tons capacity. Automatic combustion control is provided. Cottrell precipitators, consisting of three banks per boiler, are installed

Huntley Station

An addition of 200,000 kw. to the Huntley station of the Niagara Hudson system to operate in conjunction with hydro and a large transmission system called for pioneering. A low load factor called for low first cost without sacrifice of reliability. The building proper was built for 36.5 cents per cubic-foot.



Two 100,000-kva. units in Huntley station

Two single-shaft, 100,000-kva. turbo-generators to operate at 12,000 volts at 1,800 r.p.m. were selected. Four boilers were installed, but three only can deliver the 1,640,000 lb. of steam per hour required by the turbines for 160,000 kw. net output. Each boiler is 60 sections wide, 22 tubes high and has 36,792 sq.ft. of heating surface and a 9,350-sq.ft. interdeck multiple-loop superheater. The 3,301 sq.ft. of heating surface in the four furnace walls and the 900 sq.ft. in the water-cooled furnace bottom surround a 22,-900-cu.ft. furnace designed for a heat release of 32,300 B.t.u. per cubic-foot at 560,000 lb. of steam per hour.

The four lower rows of tubes in the boiler are double spaced horizontally and vertically to form a slag screen. Furnaces are of the slag tap design. A direct-fired pulverized fuel system is used with automatic ignition by an electric spark.

There are two 450,000 sq.ft. regenerative air heaters per boiler and secondary air enters the furnace at 600 deg. at full load. Two boiler feed pumps are provided for each turbine unit with a fifth as spare. Condensers are 45,000-sq.ft. single-pass units with steam jet air removal. Each of the two circulating water pumps is driven by two-speed squirrel-cage motors.

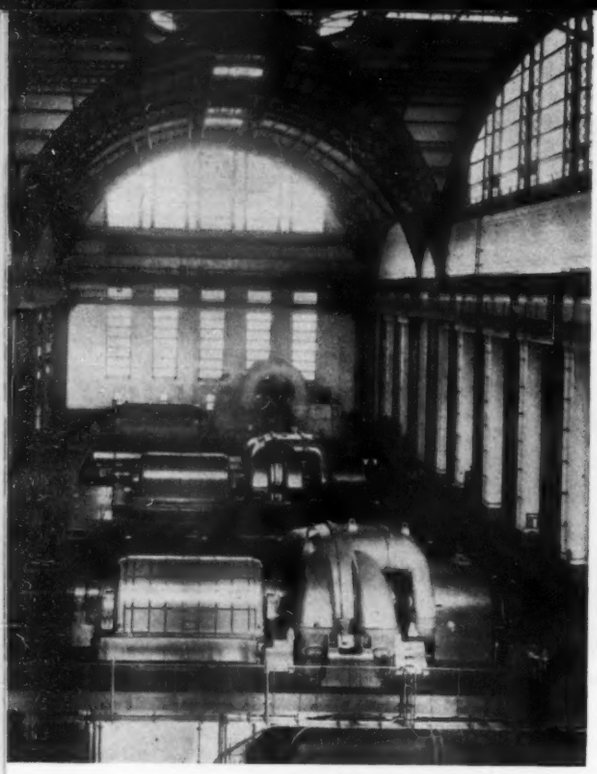
This station is noted for its pioneering use of slag bottom boilers and its adaptability to start quickly and handle variable load demands.

Best British Station Performance

In England the Battersea station is an outstanding power plant. Through the courtesy of W. S. Monroe of Sargent & Lundy and Sir Leonard Pearce of the London Power Company, Ltd., we are able to give the 1935 performance data on this notable station.

Performance of Battersea Station—1935

Maximum demand on generators	133,300	Average steam temperature at boiler stop valve, deg. F	837
Maximum demand supplied from station	126,850	Average steam pressure at boiler drum, per square inch gage, lb	608
Kilowatt-hours generated	797,749,600	Average inlet temperature of cooling water, deg. F	58
Kilowatt-hours supplied from station	753,097,400	Average feedwater temperature to economizer, deg. F	323
Kilowatt-hours used on works	44,652,200	Percentage ash to total fuel burned, per cent	8.21
Load factor, per cent	67.77	Average percentage CO_2, per cent	14.9
Plant load factor, per cent	76.09	Average flue gas temperature, air heater outlet, deg. F	261
Fuel consumed, tons	343,474	Percentage make-up water to total water evaporated, per cent	1.76
Average gross calorific value of fuel consumed, British thermal units per lb	12,380	Water evaporated per kw.-hr. supplied from station, lb	9.792
Lb. of fuel per kw.-hr. supplied from station	1.0216	Water evaporated per lb. of fuel, lb	9.585
Over-all thermal efficiency per kw.-hr. generated, per cent	28.56	Boiler efficiency, over all, per cent	87.99
Over-all thermal efficiency per kw.-hr. supplied from station, per cent	26.98		



Richmond station has 285,000 kw. capacity

Power in Philadelphia

Fundamentals in Generating Station Design and Operation of the Large Steam-Hydro System of the Philadelphia Electric Company—Examples of Present Installation

By N. E. FUNK
Vice-President Philadelphia Electric Company

GENERATING stations on the system of the Philadelphia Electric Company have been designed, in most cases, by the company's engineering staff. Where the engineering has been performed by other organizations, the design has still been under the supervision and control of the company engineers. One of the major functions of the latter group in either case is to provide the desired co-ordination between design and operating features of the proposed plant. Since the engineering staff is a part of the operating company, it maintains extremely close contact with the plant supervisory and operating forces, so that the operators' suggestions for improvement in plant operation and their experience with equipment and its arrangement are available to the engineers.

In order to obtain the maximum advantage of this operating experience individuals from the supervisory forces, who will be responsible for operation of the plant, have been actually brought into the engineering department during progress of the design. On completion of design these supervisors observe, in an inspection capacity, the installation and preliminary operation of the equipment. Frequently members of the engineering organization have presented in lecture form to the plant operating forces informative discussions on features of the system to be installed.

This close co-operation between engineering and operating departments during progress of the design has resulted in development of a plant satisfactory to the operators and one with which they are thoroughly familiar prior to operation, with the result that they expend every effort to secure the best performance possible.

Choice of the site for a steam-electric power station involves so many engineering and economic problems that it would be impossible fully to discuss this feature here. A paper presented by the writer before the Franklin Institute on March 18, 1936, "The Fundamental Factors Controlling the Choice of Steam-Electric Generating Station Sites," discusses the problem in considerable detail and the following factors determining the best location have been presented in it:

1. Accessibility of water supply.
2. Accessibility of fuel supply.
3. Plant size.
4. Conditions affecting transmission of power.
5. Foundation conditions.
6. Cost of land.
7. Accessibility of labor supply.

Although these factors are in the usual order of their importance, local conditions frequently alter this relationship. It is, of course, fundamental that, in considering the various factors, operating and maintenance costs must be carefully balanced against fixed charges on the investment. It does not always follow that because the site selected permits the lowest capital expenditure it is the most economical site for the purpose. Consistent with reliability of service to the system, the plant site finally selected should give the lowest relative annual cost. These costs involve fixed charges on plant and transmission facilities together with expense of operating both of these facilities.

Locating stations

Selection of a location for hydroelectric generation cannot be made in exactly the same manner as is used in selection of a steam plant site. Availability of water at a point where reasonable head conditions exist and the ability to construct the dam and plant at reasonable cost are the first important factors. Location of the plant in

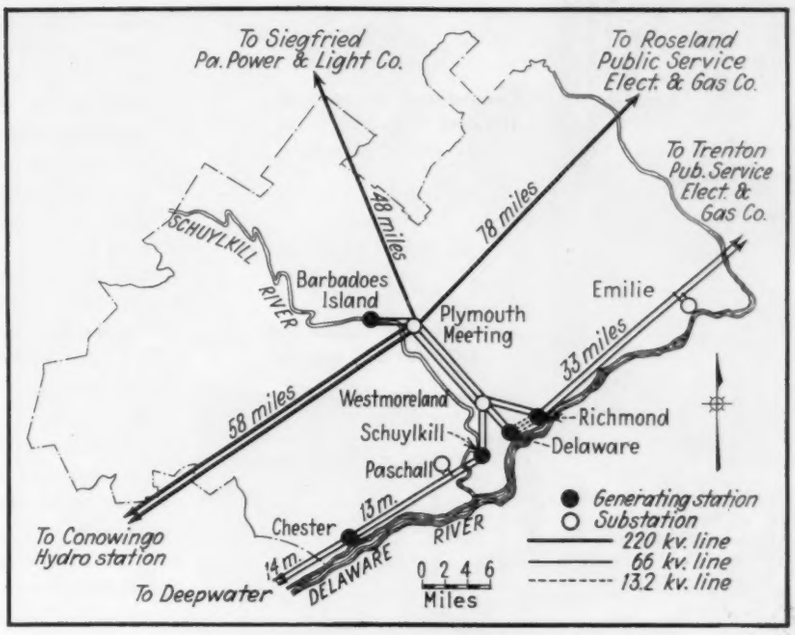
relation to the distribution system must, however, be very carefully considered, since it is possible that the plant may be so remotely located that it will not be economically possible to deliver the power at the point of use.

Influence of interconnection

The Philadelphia Electric Company System has points of interconnection with other operating companies. This fact has considerable influence on several factors affecting design and operation, as follows:

1. Selection of the company from among the interconnected group which will install any new plant.
2. Selection of site for the plant.
3. Size of unit to be installed.
4. Permissible economy to be incorporated in the design.

Operating savings accruing to each company through interconnection dictate the advisability of operating each plant in the interconnected group in the same manner that it would be operated if all of the plants in the group were in a single operating company's system. This is accomplished through an interconnection committee, with members from each of the operating companies in the group. They have available, constantly, data regarding base and increment operating costs for each of the plants. The committee also has full details regarding load to be carried in the group and in each plant.



System layout of Philadelphia Electric Company

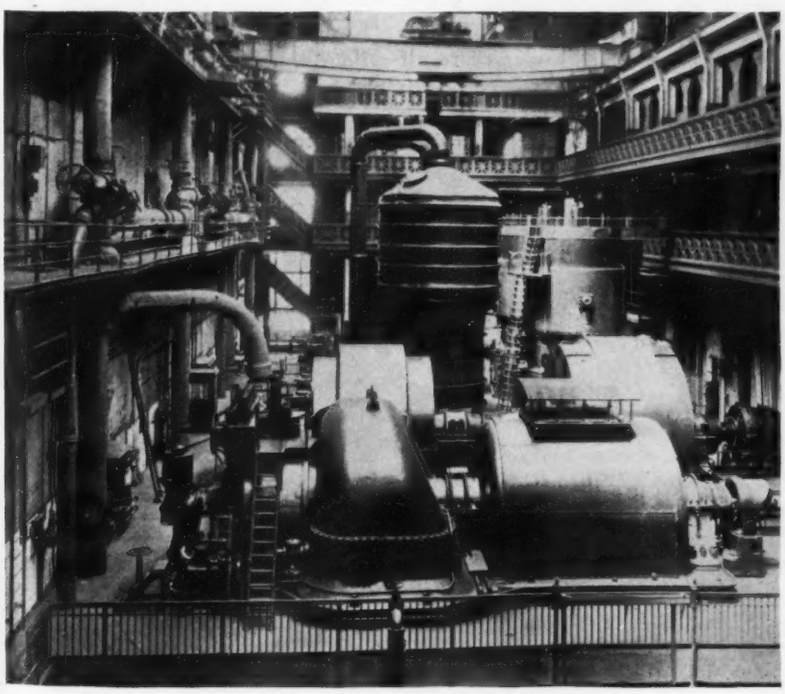
Because of the above-described method of operation it follows that it is also in the interest of economy to provide for estimated increase in load at the point in the interconnecting system from which the delivered energy can be secured at the lowest cost. Factors 1 and 2 are decided on from complete discussion and careful analysis with this thought in mind. Transmission expense as discussed above under "Selection of plant site" is also involved in this problem.

Plant location selection, however, is influenced in the co-operative interconnection plans by local factors appearing in the individual systems, such as transmission limitations in local areas and the deficiency or excess of capacity compared to the load in the individual systems. Another element affecting the decision concerns reliability of load service in high-density areas which if fed only from remote points might be subject to transmission interruptions.

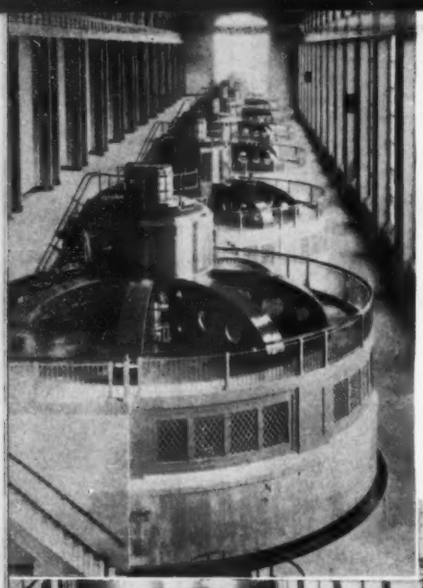
Factor 3, "Size of unit," is very largely influenced by the magnitude of the load carried in the interconnected group. For instance, a unit of 165,000 kw. capacity, recently installed at Richmond station in the Philadelphia Electric Company System, is not too large for service in the interconnected group under discussion, having a total load of about 2,000,000 kw.

Factor 4, "Permissible economy to be incorporated in the design," is affected to possibly a lesser degree by interconnection than some of the other factors. However, since interconnection usually increases capacity and load factors, higher economy can be justified. Here the economics, or relative total annual costs as discussed later under "Selection of equipment," have a major influence in decisions affecting designed plant efficiency.

All of the above factors are influenced in the system under discussion by the Conowingo hydro-electric station, which at certain periods of the

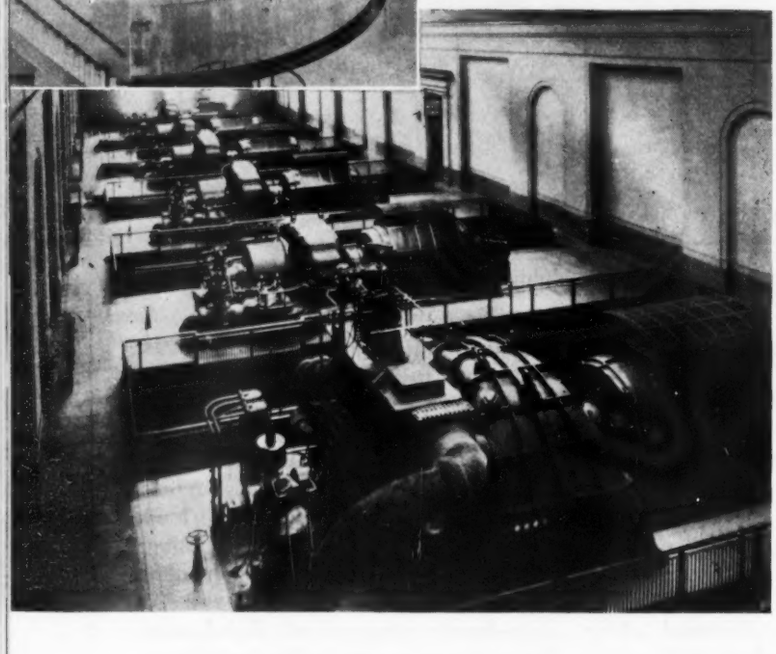


Schuylkill station will have a superposed unit



Conowingo hydro of 388,000 hp. ties into the steam plants

Delaware station has 183,000 kw. capacity



year supplies base load and, at other times, only peak capacity.

Selection of equipment involves the same economic laws that are followed in the selection of the site, except that reliability must be given considerable weight in the factors involving the choice. The lowest annual cost, including fixed charges and operating expense, must be calculated on the basis of the expected average capacity factor over the life of the plant. Many new plants having greater economy than can be obtained in the older plants are placed in operation with very high capacity factor, but as time goes on and still better designs are employed in newer plants on the system, this capacity factor steadily decreases until the plant may reach the point where it is used only for peak-load or stand-by service. Undue weight in making a selection is never given to the mere fact that equipment, as, for instance, a turbine or boiler, may operate at high efficiency.

The factor of reliability does not preclude the selection of new developments, although they are very carefully considered before such selection is made. Confidence in the manufacturer and experience with previous new developments of the same character have considerable bearing on the decision.

Operating performance of the Philadelphia Electric Company's steam-electric plants, as measured by heat rates for the system and for individual plants, is the result of the application of the fundamental outlined above, and are as follows for the system and the individual plants:

For the year 1935 the average heat rate for steam plants on the system was 14,331 B.t.u.'s net per kilowatt-hour at an average load factor of 45.5 per cent; including hydro generation the load factor for that year was 51.3 per cent. This over-all result is made up from the plants, which are briefly discussed below.

Schuylkill Station — This plant, originally constructed in 1902, was continuously altered and added to until 1914, when two horizontal turbines, one 30,000 kw. and one 35,000 kw., were installed. The other generating equipment consists of a 20,000-kw. horizontal, one 14,000-kw. and three 15,000-kw. vertical turbines. Operating steam pressure at this plant is 200 lb. per square inch. It is contemplated that the next generating capacity for the Philadelphia Electric Company and the interconnected system will be a 50,000-kw., 1,200-lb., 900-deg. F. turbine unit superposed in this station. Performance at this plant in 1935 for peak-load service only was 34,410 B.t.u.'s per net kilowatt-hour, with a capacity factor of 1.6 per cent and a load factor of 5.6 per cent.

Chester Station—Placed in operation in 1918, this station now includes two 30,000-kw. and two 33,000-kw. units operating with stoker-fired boilers at 265 lb. per square inch pressure. For 1935 its generation was at the rate of 18,122 B.t.u.'s per net kilowatt-hour, with a capacity factor of 22.1 per cent and a load factor of 24.4 per cent.

Delaware Station—First placed in operation in 1920 and now includes five 30,000-kw. and one 33,000-kw. units. These units are served by stoker-fired boilers with steam at 265 lb. per square inch pressure. Its performance during 1935 was 19,164 B.t.u.'s per net kilowatt-hour at a ca-

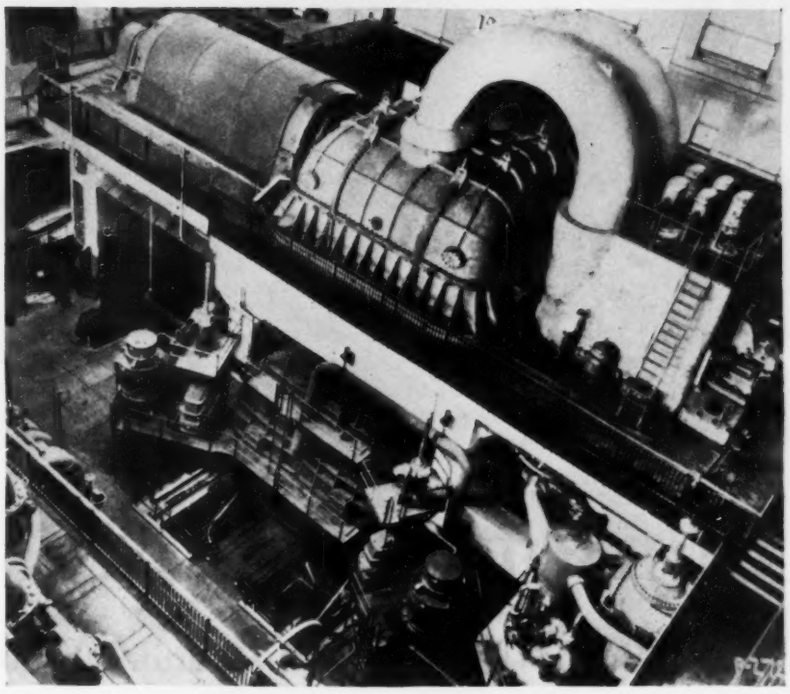
Chester station has unusual architecture

pacity factor of 12.2 per cent and a load factor of 14.4 per cent.

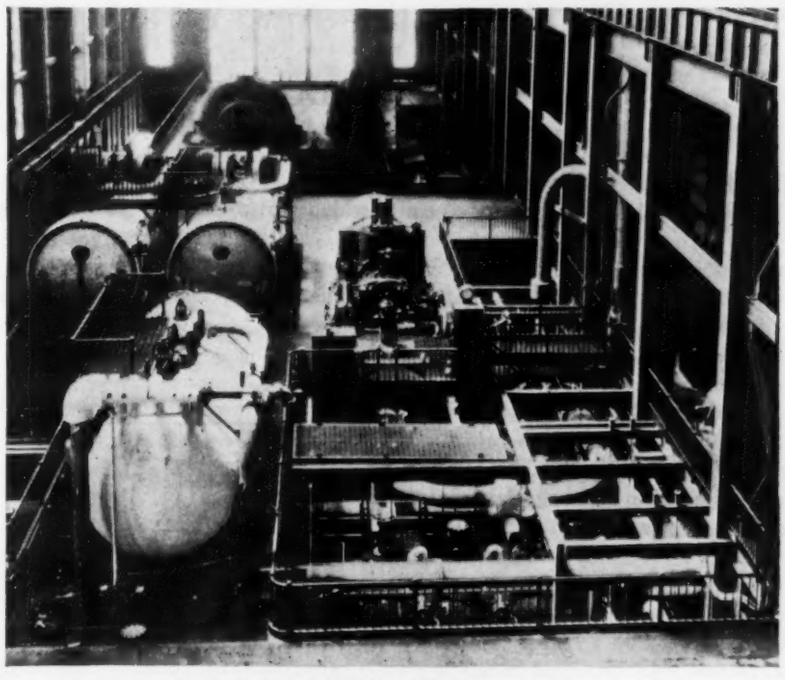
Richmond Station—Operated initially in 1925, it has two 60,000-kw. units with stoker-fired boilers operating with steam at 400 lb. per square inch pressure and 725 deg. F. total temperature. A 165,000-kw. unit, placed in service in this plant late in 1935, operates from pulverized fuel-fired boilers with steam at 400 lb. per square inch pressure and 850 deg. F. total temperature. This unit was boilered for only 135,000 kw. of its capacity. Its remaining capacity will be supplied by an additional boiler when required by load demands. The heat rate for this plant during 1935, which was affected for only a short time during the initial operating period for the new unit, was 13,586 B.t.u.'s per net kilowatt-hour, with a capacity factor of 64.0 per cent and load factor of 38.4 per cent. In calculating the capacity factor the large unit was considered as having only 135,000 kw. capacity.

Deepwater Station—Placed in operation in 1930, this station is jointly owned and operated by the Atlantic City Electric Company and Deepwater Light & Power Company, the latter a subsidiary of Philadelphia Electric Company. This plant has two 58,000-kw. cross-compound turbine units operated from pulverized fuel-fired boilers with steam at a pressure of 1,250 lb. per square inch, 725 deg. F. initial temperature and 750 deg. F. reheat temperature. The plant is unique in that a 12,500-kw. high-pressure turbine, operated at a pressure of 1,250 lb. from pulverized fuel-fired boilers, supplies electrical energy and steam to an adjacent industrial plant of E. I. duPont de Nemours & Company. The heat rate for the power company's units for 1935 was 11,845 B.t.u.'s per net kilowatt-hour. The capacity factor, including all generation for that year, was 91 per cent and the load factor was 81 per cent.

Conowingo Hydro-Electric Plant—This station has been operated since March 1, 1928. Its equipment comprises seven 54,000-hp. main units, operating at 81.8 r.p.m. with a head of 89 ft. Each unit requires approximately 6,000 cu.ft. of water per second. Since the river flow is extremely variable, the plant can operate on base load for only a portion of the year. This has considerable influence on steam plant performance throughout the interconnected system, resulting in somewhat higher heat rates than if there were no hydro power.



A 165,000-kw. unit in Richmond station



Joint industrial-utility Deepwater station

The above individual plant heat rates are given merely as a matter of interest. The plant design is based not necessarily on the best possible individual plant performance, but on the individual and interconnected system performance, which has a great influence on the individual plant.

This principle is also carried out in the operation of the plants. Each plant has a bogey or performance standard covering the entire range of operating conditions. Actual performance is checked against this bogey and this becomes the criterion of the plant's performance rather than the heat rate of the plant. The bogeys are the basis for loading the plants on the system so as to secure the most economical system performance, which frequently does not favor the most economical plant.

Central control board for use of 5,493,443,200 kw.-hr. in 1935

Consolidated Edison System

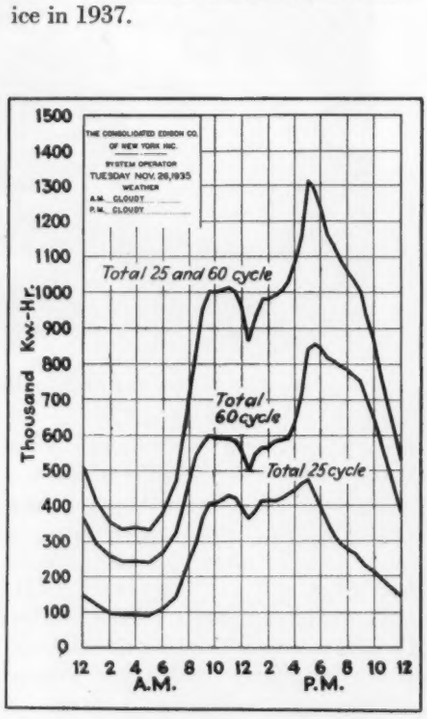
Service to 700 Square Miles and 7,000,000 People — Multiple Steam Plant and Interconnections — Service, Load and Control Requirements — New York Area Requires 2,298,200 Kw.

By W. H. LAWRENCE
Chief Operating Engineer New York Edison Company

ELECTRIC companies of the Consolidated Edison System supply electric service to four boroughs of New York City and also to Westchester County. Four of the five boroughs of New York City served by the system include about 98 per cent of the city's population. The total area covered by the system's service is about 700 square miles, wherein dwell some 7,000,000 people. Service includes domestic, commercial, industrial and traction loads, and, with the exception of 1931 and 1932, the system has shown a steady increase in output of energy. In 1935 the total output was 5,493,443,200 kw.-hr. The peak load of that year occurred at 5 p.m. on November 26 and was 1,319,000 kw.

The system is served by eight steam-generating stations, containing 52 turbo-generating units with a total capacity of 2,298,200 kw. Capacities of these units range in size from 5,000 to 160,000 kw. Steam pressures range from 200 to 400 lb. gage and the temperatures from 500 to 750 deg. F. Steam for these turbines is supplied by boilers varying in capacity from 30,000 to 800,000 lb. of steam per hour per boiler.

There is now being installed at Waterside station a 50,000-kw. unit which will operate at a steam pressure of 1,200 lb. per square inch and exhaust into the 200-lb. station steam headers. This machine will be in service in 1937.



Load of Consolidated Edison System on peak day of 1935 reached 1,319,000 kw.

In addition to the generating equipment, there are two 130-kv. transmission lines of 150,000 kw. rated capacity connecting the Edison System with the Niagara Hudson System. These transmission lines run overhead from the Niagara Hudson System at Pleasant Valley to Dunwoodie substation, a distance of 60 miles, then underground via 132-kv. cables to Hell Gate station, a distance of 12 miles. Niagara Hudson System has a generating capacity of 1,700,000 kw., more than half of which consists of hydraulic turbines. During 1935 about 900,000,000 kw.-hr. was supplied to the New York Edison System over the transmission lines. The bulk of this energy was generated by the hydro plants.

Operation of the system, including energy interchange with the Niagara Hudson System, is co-ordinated from a central system operation office in mid-Manhattan. On the system office and pilot board the position (open or closed) of the switches at the generating stations is indicated antomatically. There are installed on the system operators' pilot board indicating wattmeters which show the load, both 25 and 60 cycle, carried by each of the various generating stations, the load on

the Niagara Hudson tie lines, total generated, both 25 and 60 cycle, and total system load. In addition to the indicating meters, curve-drawing wattmeters record the load received from or delivered to the Niagara Hudson System, total load generated and total system load.

The generating stations are all connected together through tie cables, the 25- and 60-cycle systems through three 40,000-kw. and two 35,000-kw. frequency changers, so that the system operates in parallel as a unit.

Detail of load control

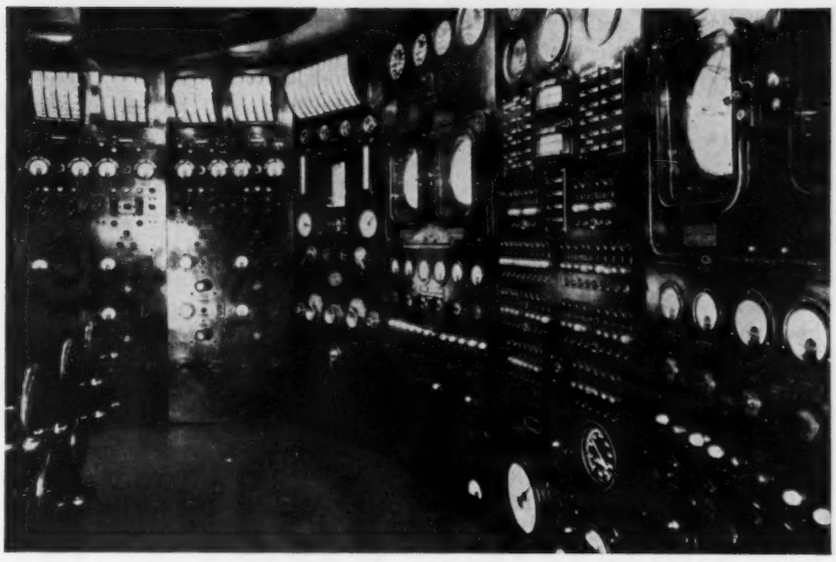
From a central point the system operator directs the distribution of load among the various generating stations. His duties require him to maintain in operation at all times sufficent generating capacity to carry any demand upon the system, and in addition excess generating capacity equal to the largest unit in operation so that the system functions normally if the largest unit is for any reason lost. To guide him in the loading of the various generating stations he is furnished a loading schedule showing the economical loading of each generating station with any system load. In apportioning the load among the generating stations he follows this schedule as closely as he can, consistent with reliability and continuity of service.

Manhattan Island south of 135th Street is supplied with both direct current and 60-cycle alternating current at the present time.

The direct-current system is supplied from some forty substations which receive 25-cycle energy and convert it by means of synchronous converters to 120/240 volts direct current for distribution. The 25-cycle energy in addition to supplying the direct system also supplies several railroad systems, such as the Third Avenue, Hudson & Manhattan, New York Central, New York, New Haven & Hartford and part of the Long Island. The direct-current system is gradually being changed over to 60-cycle so that eventually only 60-cycle energy will be distributed.

Except for a very small area of direct-current distribution in Brooklyn, which will eventually be superseded by 60-cycle alternating, all the rest of the system is supplied with 60-cycle alternating current distributed radially or by the network system.

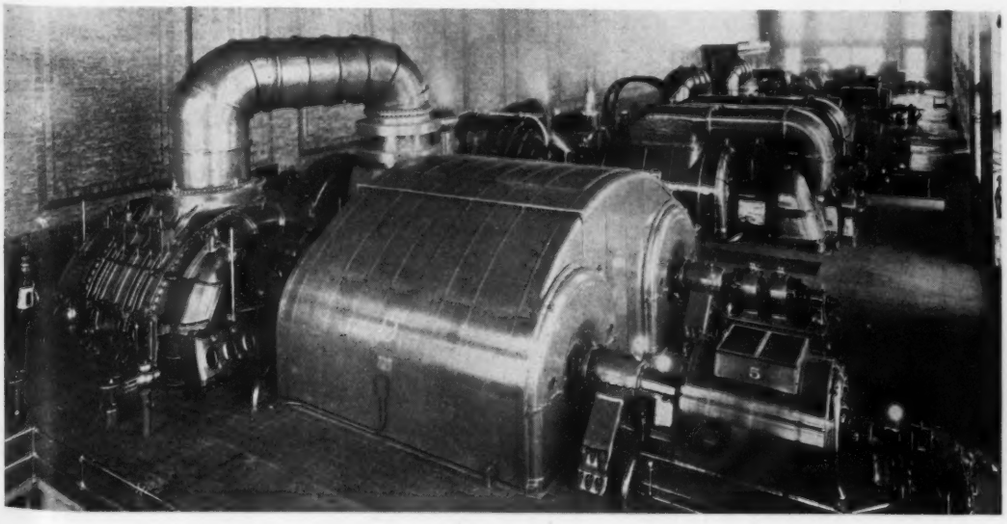
Simplification of load transfer between the Edison System and the Niagara Hudson System and between the stations of the Edison System, as well as considerations of economy, made it imperative that standard frequency be maintained at all times. To accomplish this automatic frequency control is used on some of the Hell Gate station turbo-generators. A by-product of frequency control is the service to the many customers owning electric clocks. Frequency is so regulated that the error in electric clock time does not exceed (plus or minus) one second at any time.



Instrument and control panel for two 800,000-lb.-per-hour boilers at Hell Gate

Major station details

Hudson Avenue Station—This is located at Hudson Avenue and the East River, Brooklyn, and has an installed capacity of 770,000 kw. It is the largest generating station in the world. All units generate energy at 13,800 volts except the two 160,000-kw. units, which generate at 16,500 volts. Generated voltage is stepped up to 27,000, which is the bus voltage, by means of auto-transformers. Three 50,000-kw., 1,200 r.p.m., single shaft turbo-generators operate at 265-lb. steam pressure and 650 deg. F. steam temperature and are supplied from twelve underfeed stoker - fired boilers, each having a capacity of 146,000 lb. of steam per hour. The remaining units operate at 400 lb. pressure and 700 deg. F. and consist



Turbine room at Hell Gate, two 160,000-kw. units in foreground

of one 80,000-kw. and two 110,000-kw., 1,800-r.p.m. cross-compound turbo-generators and two 160,000-kw., 1,800-r.p.m. tandem-compound turbo-generators.

Boiler ratings

Boiler equipment for supplying the 400-lb. pressure units consists of four 235,000-lb.-per-hour, eight 312,000-lb.-per-hour and eight 452,000-lb.-per-hour underfeed stoker-fired boilers. All of these boilers feed into an interconnected system of headers, the 265-lb. and 400-lb. pressure section being connected through a desuperheater and pressure-reducing valve. The smaller boilers are of the cross-drum, straight-tube type. The 452,000-lb.-per-hour boilers are bent-tube multi-drum with completely water-cooled furnace walls, equipped with stokers 26 ft. wide and 27 ft. in length. These stokers are driven by hydraulic variable-speed transmission.

Each of the 160,000-kw., tandem-compound units occupies an area 24 ft. wide and 86 ft. long. The turbines each have one velocity compounded stage and fourteen high-pressure stages plus four double-flow stages in the low-pressure cylinder. The last low-pressure stage is 12 ft. 9½ in. diameter over all, with blades having an effective length of 38 in., the peripheral speed being 1,205 ft. per second. These turbines each exhaust into a single-pass condenser containing 14,710 tubes of ⅞ in. O.D. and 30 ft. long between tube sheets, giving a cooling surface of 101,000 sq.ft. Each generator of the 160,000-kw. unit feeds two separate bus sections. This is accomplished by means of separate windings on the auto-transformers, which steps up the generator voltage of 16,500 to the bus voltage of 27,000.

Hell Gate Station—This plant is situated at 134th Street and Locust Avenue, The Bronx, and has an installed capacity of 605,000 kw. It operates at 265 lb. steam pressure and 700 deg. F. There are nine turbo-generating units. Three 35,000-kw. single-cylinder units operate at 1,500 r.p.m. and generate 25-cycle energy at 11,400 volts. The remaining six units generate 60-cycle energy at 13,800 volts and are as follows: Two 40,000-kw. tandem-compound, 1,200-r.p.m.; two 50,000-kw. cross-compound, 1,800-r.p.m., and two 160,000-kw. cross-compound units. The 160,000-kw. units are different in design; both the high- and low-pressure elements of one turbine operate at 1,800 r.p.m.; the high-pressure element of the other also operates at 1,800 r.p.m., but the low-pressure element operates at 1,200 r.p.m. The condenser for each of these units is of the double two-pass type, containing 30,000 tubes of ⅞-in. O.D. 17 ft. long, having a cooling surface of 137,500 sq.ft.

Boiler equipment consists of 21 underfeed, stoker-fired, cross-drum boilers, ranging in capacity from 165,000 to 250,000 lb. steam per hour, three pulverized-coal-fired, cross-drum boilers, each having a capacity of 400,000 lb. per hour and two pulverized-coal-fired, sectional, twin, vertical header, cross-drum boilers, each having a capacity of 800,000 lb. steam per hour. The pulverized-coal-fired boilers are equipped for slag tapping and use the unit combustion system.

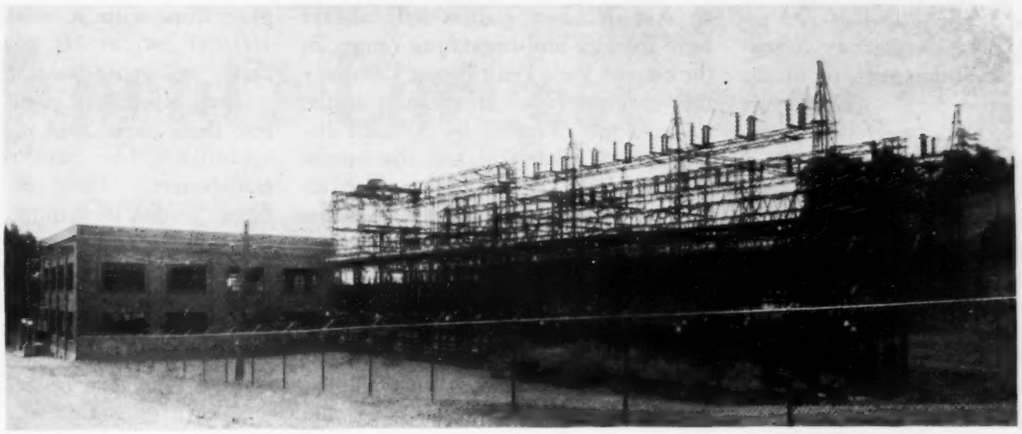
East River Station—Located at Fourteenth Street and the East River, Manhattan, this station has an installed capacity of 280,000 kw. It generates 25-cycle energy at 11,400 volts and all turbo-generators operate at 1,500 r.p.m. It has two 60,000-kw., single-cylinder turbines and one 160,000-kw. tandem-compound turbine having an initial steam pressure of 400 lb. and 700 deg. F. temperature. The condenser serving the 160,000-kw. unit contains 15,100 ⅞-in. O.D. tubes 26 ft. long, has a cooling surface of 90,000 sq.ft. and is of the single-pass type. Steam for these units is supplied from six horizontal cross-drum boilers, each having a capacity of 250,000 lb. of steam per hour, and three Ladd type boilers having a capacity of 800,000 lb. of steam per hour. Coal for the boilers at this station is pulverized in a separate mill house across the street by four 25-ton and two 15-ton per hour air-swept mills. The coal from the mills is fed to storage bins at each boiler.

Electrical galleries of Hudson Avenue, Hell Gate and East River are constructed on the isolated phase principle. Hell Gate station uses horizontal phase isolation where each phase is separated by a vertical wall. Both Hudson Avenue and East River use the vertical phase isolation systm.

Waterside Stations—These are located at 38th-40th Streets and the East River, Manhattan, and have now installed 326,000 kw., 59,000 kw. of which is 60-cycle and 267,000 kw. 25-cycle. Capacity of the turbo-generators ranges from 5,000 kw. to 35,000 kw. Steam for these turbines is supplied from 110 stoker-fired boilers. As previously stated, a 1,200-lb. machine at Waterside stations is now under construction. This installation will consist of a 50,000-kw., 50-cycle, 3,600-r.p.m. turbo-generator, operating at 1,200 lb. normal steam pressure, and 900 deg. F. steam temperature and

[*Continued on page 142*]

Turbine room at East River, two 60,000-kw. units in foreground and one 160,000-kw. in rear



Lake Lynn hydro plant

West Penn Power Supply

West Penn Serves 8,770 Sq. Miles in Western Pennsylvania —132-Kv. Transmission and Multiple Generating Stations— Operates 397 Miles of High-Voltage Line in Six Sections

By W. R. HAMILTON
Superintendent of System Operation, West Penn Power Company

THE West Penn Power Company serves the southern and central sections of western Pennsylvania. The territory surrounds the Pittsburgh metropolitan area on three sides and extends from the West Virginia line northward to the New York State line. Included in West Penn's territory is also a small area removed from the main territory served comprising the towns of Bellefonte and State College, in the exact center of the state. The total area covers 8,770 square miles and is populated by numerous towns and small cities, the largest of which is Washington, containing 24,500 people. Total number of customers served is 185,000. The type of load differs from that of most companies because of the high proportion of industrial business. Industrial makes up about 70 per cent of the total load; residential is only about 9 per cent, commercial about 5.5 per cent and electric railways 1.3 per cent. The industrial load is composed principally of steel, which is 34 per cent of the total, coal 32 per cent and glass 15 per cent. These three industries use almost four-fifths of the industrial power generated.

Principal generating stations are Springdale, Windsor, Connellsville and Ridgway steam stations and Lake Lynn hydro station. A double-circuit 132-kv. steel tower line extends from Windsor power station in West Virginia on the west through Washington substation to Charleroi substation, the principal dispatching center, and then on to Springdale power station. Another double-circuit 132-kv. tower line extends from Charleroi south to Lake Lynn power station, where one 132-kv. line connects with the Potomac Edison Company in the east and three 66-kv. lines connect with Monongahela West Penn Public Service Company to the south in West Virginia. Both of these utilities are affiliated companies.

Four additional 132-kv. tower lines radiate from Springdale power station, three of these being double-circuit tower lines terminating at Luxor, Butler and Kittanning substations, respectively. A single-circuit 132-kv. line from Kittanning extends north and connects with the Piney hydro station of Pennsylvania Electric Company and the northern territory of the West Penn System. The fourth 132-kv. line, extending from Springdale, connects with Duquesne Light Company at its Colfax power station.

Details of transmission

Transmission system comprises 397 miles at 132,000 volts, 143 miles at 44,000 volts, 3 miles at 33,000 volts and 1,426 miles at 25,000 volts. Because of the great number of small towns and industrial customers served, the large substations are only those stepping down from the 132-kv. transmission system. There are 29 substations having 24-hour attendance, 33 automatic substations, either partially attended or without any regular operator, and 23 automatic substations operated by customers' employees. Application of automatic reclosing breakers and immediate reclosing relays is being extended

rapidly in both non-attendant and attendant stations. Numerous transformer stations of moderate sizes up to 1,000 kva. on the 25,000-volt system are served by automatic operated air-break switches.

Frequency regulators at Windsor

The entire system is divided into six major sections because of the wide extent of the area covered. Windsor Power station is at the point of connection with the Ohio Power Company and is the principal frequency regulating station for an interconnected system of more than 7,000,000 kva. spinning capacity, which extends beyond Chicago in the West and into the states bordering the Gulf of Mexico in the south. As Windsor maintains frequency regulation by automatic frequency control, it is the responsibility of the two companies to the east and west to maintain the loading of their tie lines to Windsor so that Windsor station will always have loading and regulating range. In the case of West Penn Power Company this requires close supervision of the tie lines into Windsor by the load dispatchers at Charleroi and the operators at Lake Lynn and Springdale through remote metering installations. This is necessary so that the station which is regulating to maintain the Windsor load will have a continuous record of the load being regulated. As Lake Lynn hydro station is a run-of-the-river station, with only limited storage, regulation of load on the Windsor tie lines has to be handled by steam stations when the river flow at Lake Lynn is excessive or is very limited.

Lake Lynn hydro station has four units with Francis wheels, a total capacity of 54,000 kw. and a maximum head of 81.5 ft. The dam is of the gravity type, approximately 100 ft. high and 1,000 ft. long, and the storage pond has a maximum capacity of 72,338 acre-feet. The flow of the river is extremely variable.

Windsor station is owned jointly by the West Penn Power Company and the Ohio Power Company and furnishes power to the two companies' substations from the 11-kv. generating bus. There are six 30,000-kw. units installed, providing a total of 180,000 kw. capacity.

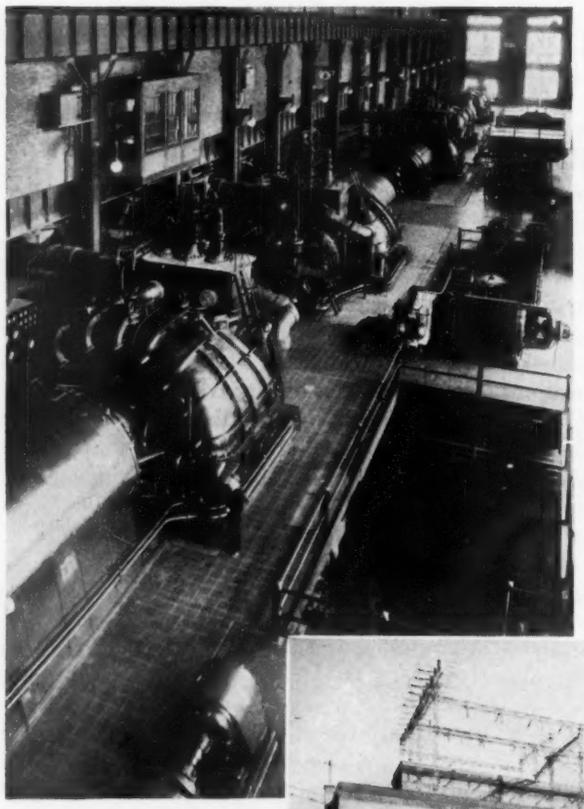
Springdale station at present has five 1,800-r.p.m. turbo-generators with a total capacity of 160,000 kw. at 80 per cent power factor and generates at 11 kv.

The electrical plant is divided into three parts, each section stepping up to the 132-kv. bus through separate transformers. Only one of these sections feeds the minor 25,000-volt transmission system. Steam-generating capacity includes fourteen boilers, twelve of which are stoker fired and two powdered fuel. One of the powdered fuel boilers, which was of the storage type, has been dismantled to take care of station expansion. The remaining powdered fuel boiler is direct fired. The normal steam pressure is 350 lb. on boilers Nos. 1 to 5 and 375 lb. on boilers Nos. 7 to 14 and the temperature 710 deg. All boilers are equipped with superheaters and eight of them with economizers. Steam flows to separate headers for each unit and all are connected to one main steam system. Forced- and induced-draft fans are installed on each boiler.

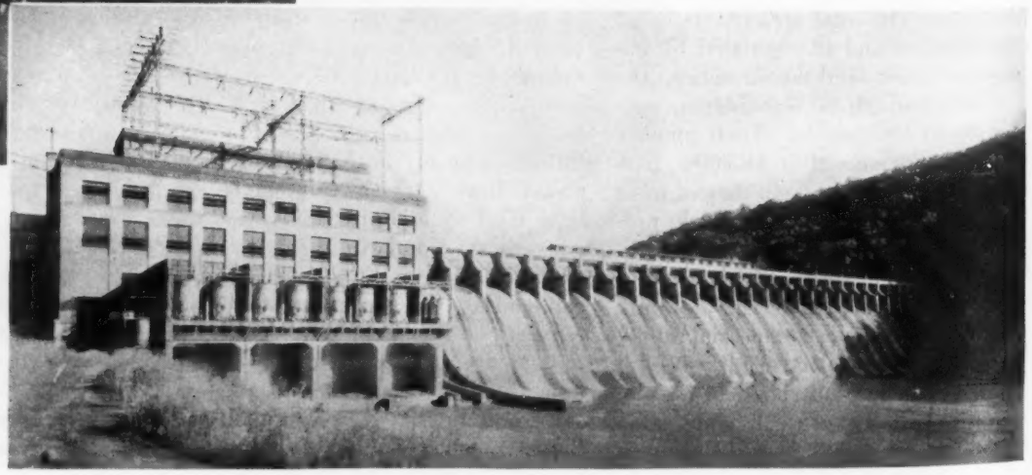
New superposed unit

Additional capacity is now being installed at Springdale to be in service during the fall of 1937. The new installation is a superposed unit of 1.200 lb. pressure at 925 deg. temperature, exhausting into the present steam header system. The generator will be of 50,000 kw. capacity at 100 per cent power factor, operating at 3,600 r.p.m., and will be hydrogen cooled. Three new high-pressure boilers are being installed with a capacity of 500,000 lb. of steam per hour each.

Both the Windsor and Springdale stations are mine-mouth stations, the coal mines of each being operated by subsidiary companies.



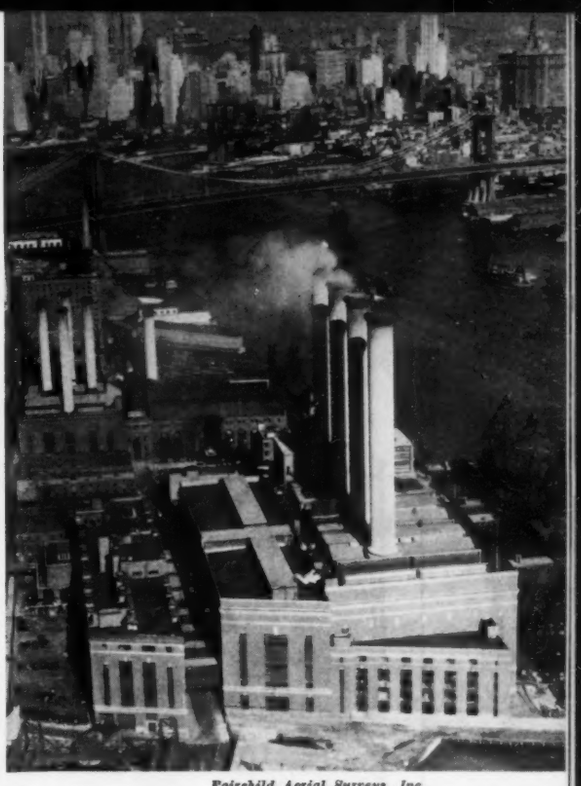
Turbine room of Springdale station



Charleroi transmission substation

World's Largest Power Station

Hudson Avenue Has 770,000 Kw. in Space Originally Intended for 400,000 —Unique Features in Design and Equipment Described—Design Based Upon Successive Extensions



Fairchild Aerial Surveys, Inc.

By J. L. LANDIS . . . J. F. FAIRMAN
Brooklyn Edison Company

HUDSON AVENUE generating station, the world's largest steam-electric station, is characterized by reliability, economy of investment and operation and concentration of power. As originally conceived, Hudson Avenue was the basic source of power for Brooklyn. then in the midst of a period of rapid load growth and served by two stations which had reached the practical limit of development. The load, characterized by high density, was supplied through a number of distribution substations. The design of the station was co-ordinated with the further development of the distribution system. The overshadowing consideration in both projects was the need for the highest possible degree of reliability, a vital necessity in a densely populated metropolitan area.

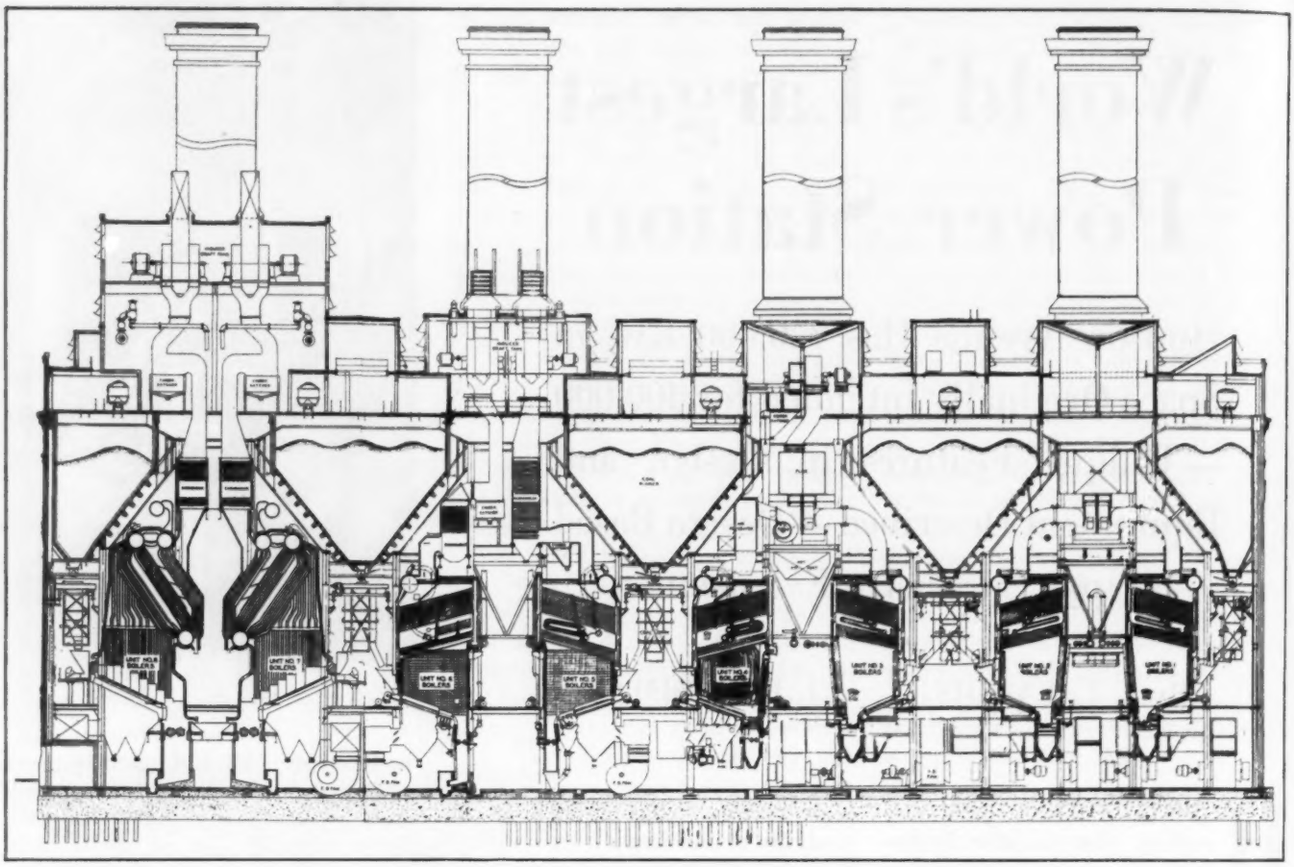
The combined influence of these considerations and local economic factors determined the general features of the station. Need for reliability dictated the use of equipment of proved ability, to operate at moderate steam temperatures, and to be combined in a simple arrangement with comprehensive automatic control. On the electrical side it led to the adoption of the principle of sectionalizing and segregating the electrical buses and equipment with diversified feeder connections so that an electrical failure would be confined to a small section and not interrupt service. Anticipated rapid load growth and the high load density pointed to the advisability of planning a large station to be constructed in successive extensions.

High land and building costs predicated a compact design with a low-unit investment, and the physical limitations of street space for feeder outlets led to the adoption of 27,600 volts as the station voltage. The high total load to be served made it economically desirable to take advantage of the low unit cost of equipment by selecting equipment in the largest sizes available. Relation between fuel costs, construction costs and operating labor costs placed a premium on the use of a simple heat balance that would combine good thermal performance with low operating and maintenance labor costs. Further operating savings were expected from the use of automatic control, which could be applied with a minimum unit cost.

Delegates to the World Power Conference will find in Hudson Avenue station of the Brooklyn Edison Company an example of the growth of a superpower steam plant in a metropolitan area. It shows the ingenuity of American engineers and manufacturers in meeting special problems and in pioneering in the design and manufacture of power units.

Construction of a station embodying these features was begun in 1922, at which time an ultimate installation of 400,000 kw. in eight units was contemplated. During the initial period of construction the water tunnels for the entire station were built, but only the first section of the foundations and superstructure was erected, to provide for three units. These first three units were of 50,000 kw. capacity and were the largest that the manufacturers were willing to build at that time. Nominally each was served by a row of four stoker-fired boilers, but steam tie lines were installed to provide increased flexibility and reliability. Boiler operation was made as nearly automatic as possible with combustion control, which maintained constant steam pressure by regulating the stoker feeding rate, the forced-draft duct pressure, the gas flow and the overfire draft.

Because the station site lacked space for outdoor coal storage, the bunkers were located in the boiler firing aisles above the boilers and designed to hold about two weeks' supply of coal for a 400,000-kw. station. Coal-handling facilities were based on water transportation. A trestle structure was erected on the dock, to carry an electrically operated coal tower, capable of hoisting and crushing 300 tons of coal per hour.



Cross-section of Hudson Avenue boiler house

An automatic electric coal railroad was installed in the boiler house to weigh the coal and distribute it to the proper bunkers. Traveling lorries were provided to receive the fuel from the electrically operated discharge gates on the bunkers, weigh it and distribute it to the stoker hoppers. A semi-automatic system of ash handling was adopted in which the ash was transported hydraulically to a settling basin on the dock.

The heat balance for these first three units was extremely simple. Two stages of feedwater heating, with steam bled from the main units, were employed, but no apparatus for heat recovery from the stack gases was provided. The design pressure was 265 lb., which was felt to be the highest that could be conservatively used on machines of the size installed.

By the time the fourth unit was planned progress had been made in the use of higher pressures and it was felt that the advantages of increasing the pressure would outweigh the disadvantage of operating at two pressures. Consequently this unit was designed for operation at 400 lb., as were all future units. Connection between the two sections of the station was made by means of a de-superheater and pressure-reducing valves. This change in design pressure resulted in a change in heat balance for the fourth unit, since at the higher pressure the most economical arrangement was one in which four stages of feedwater heating were combined with air preheating.

The general design features of the first three units were maintained in the fourth, except that progress in equipment design made it possible to increase capacity to 80,000 kw. with no increase in space. The station superstructure was completed at this time.

Installation of unit No. 5 was marked by another change in heat balance, since the large hot air ducts required by the No. 4 arrangement produced unduly high temperatures at some of the boiler house operating levels. Economizers were installed and two-stage bleeding was reverted to on unit No. 5 and the succeeding units.

During the years in which these units were constructed rapid load growth continued and Hudson Avenue station was interconnected with other stations in the metropolitan area for unified operation. It thus became economically desirable to install units of a size which would seem out of all proportion to the Brooklyn load, but which appear modest against the total metropolitan requirements. Nos. 5 and 6 turbo-generators, of 110,000 kw. each, and Nos. 7 and 8 turbo-generators, of 160,000 kw. each, were the largest of their type available at the time of installation. Corresponding increases in the capacity of condensers, boilers and auxiliaries were required and the problem of fitting these larger pieces of equipment into the previously completed station building became increasingly acute. As completed in 1932, the station had a capacity of 770,000 kw. installed in the space originally intended for a 400,000-kw. station, an unprecedented concentration of power.

Co-ordinated with electrical system

The electrical design of Hudson Avenue station has many characteristics in common with the mechanical design just discussed; continuity of service has been a paramount consideration, and a similar concentration has taken place. Adoption during the station construction of a low-voltage a.c. network as the principal method of distribution required few changes in the station plans. Such changes as were necessary were made in such a way as to maintain a consistent development throughout.

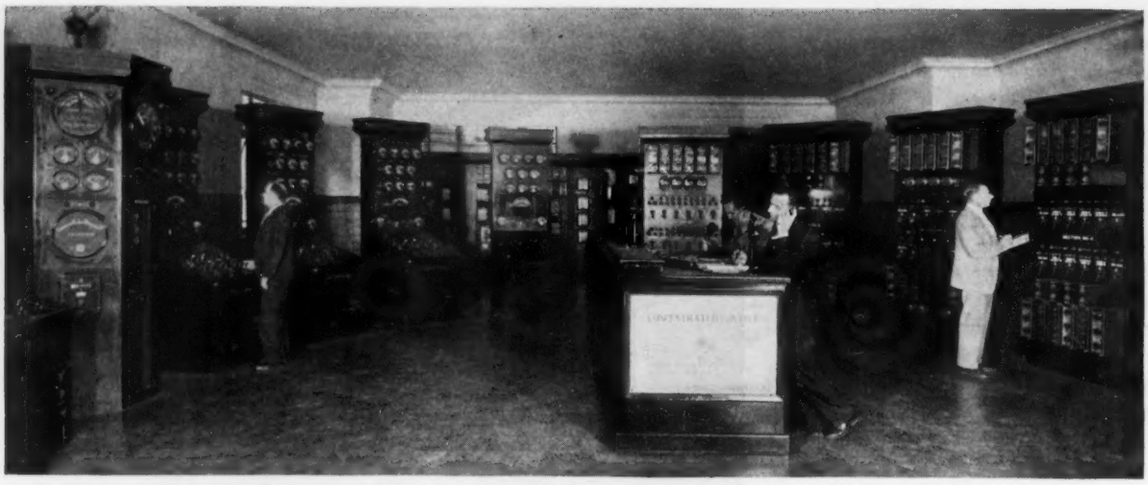
Main buses are sectionalized into eight sections, with connected generator capacities varying from 80,000 to 130,000 kw. Each section, or "H" bus, is connected through a reactor and automatic breaker to a synchronizing bus for back-up supply and load transfer purposes. The synchronizing bus, which is sectionalized by automatic breakers, is operated as a closed ring when the connected generator capacity does not exceed 310,000 kw. and in two parts when the capacity exceeds this figure. The division is so made that one branch of the double windings provided in the secondaries of the auto-transformers of the two 160,000-kw. generators is connected to each part of the synchronizing bus. The other generators, which have auto-transformers with single winding secondaries, are connected so that approximately equal capacities are connected to each part of the synchronizing bus.

Boiler firing aisle with stoker and control panels

There are two feeder group buses per "H" section, with four feeder breakers per group, and two selector breakers through which the group may be connected to either of two "H" buses. This increases reliability and makes it possible to connect feeder groups to generators in such a way that feeder loads approximate desirable generator loadings. In this way the transfer of load through the synchronizing bus and reactors is reduced, thus avoiding objectionable phase-angle and voltage differences. Feeders on most of the group buses are bifurcated by oil-immersed, metal-clad disconnects, which are combined with ground and test switches located beyond the feeder reactors. Ground and test switches without the disconnect features are provided for the feeders that are not bifurcated.

Buses and switchgear are all of the

View of 770,000-kw. turbo-generators in Hudson Avenue



High-tension control room uses individual sectionalized control panels

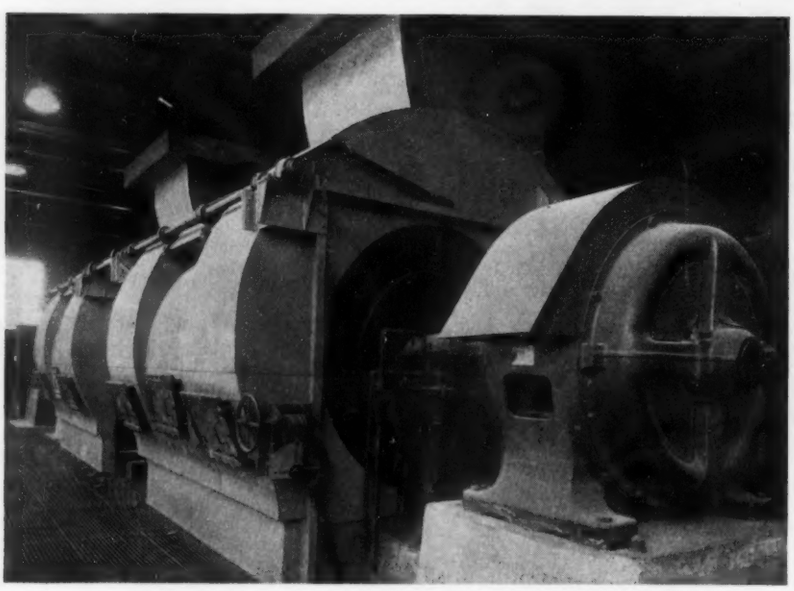
indoor type, arranged for vertical phase isolation with each section in a separate fireproof room. Circuit breakers are of the elevating disconnect type and a built-in mechanism is used for raising and lowering the three poles of each breaker. Feeder breakers have an interrupting rating of 500,000 kva., while the various bus breakers are rated 1,500,000 kva.

Synchronizing bus and generator connections are single-conductor, lead-covered cables terminating in potheads forming part of the stationary portion of the disconnecting breaker contacts. The "H" buses, group buses and connection between feeder breakers and reactors are factory-insulated copper rods or tubes carried on the stationary insulators of the breakers and reactors. The disconnecting contacts of the breakers are protected by insulating housings, and the reactors, most of which have turn insulation, are cut off from the rest of the room and separated from each other by insulating barriers. Connections to the auto-transformers are all lead-covered, single-conductor cables which are connected through pot-heads, with no exposed live parts. The eight generators are "Y" connected with solidly grounded neutrals. There are no switches between the generators and the auto-transformers.

Practically all auxiliaries are electrically driven. The 2,300-volt auxiliary buses for the first part of the station are sectionalized by automatic breakers and receive their normal supply from station transformers with alternate sources in frequency changers floating on the 25-cycle system and in house turbines that may be run if needed. In the later part of the station there are unit 2,300-volt buses which receive their normal supply from tertiary windings on the auto-transformers and are provided with an automatic throwover to common buses energized by station auxiliary transformers.

Control is centralized in separate high-tension and low-tension control rooms, in each of which there are steel control cubicles, isolated for each unit or group to minimize the likelihood of operating error or communication of electrical trouble.

Relaying has been co-ordinated with bus design to limit the effect of the failure of a protective device. Overcurrent relays on the 27,600-volt selector breakers, set selectively with the overcurrent relays of the feeder breakers, will clear quickly in case of feeder breaker or reactor failure and will trip after an appreciable time for heavy feeder faults, in case the feeder breaker fails to trip. The "H" bus is protected by differential protection in addition to overcurrent relays on the selector breakers and the breakers connecting the "H" buses and the synchronizing bus. Each section of the synchronizing bus is relayed differentially and overcurrent relays provide additional tripping protection between the "H" bus and the synchronizing bus. The generators and the auto-transformers are protected differentially and also with parallel circuit protection on all but the last two units, where the double-winding auto-transformers made this impracticable. Guards, barriers and interlocks are used extensively throughout the station as a means of reducing to a minimum the hazard to personnel or service.



Induced draft fans for Hudson Avenue boilers

Outstanding Plants in Philadelphia

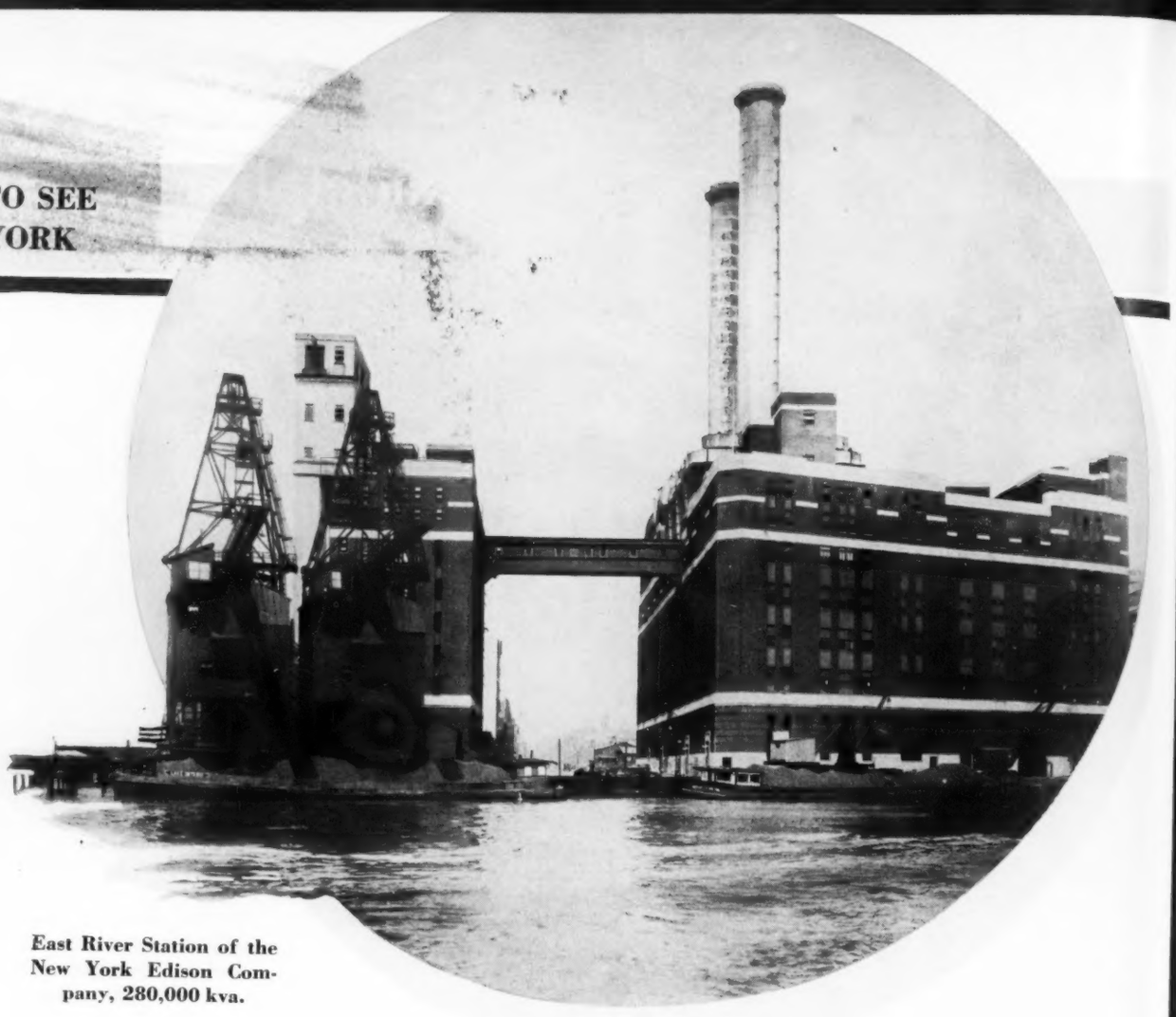
Conowingo Hydro Station—
A notable example of low-
head, variable-flow plants

Tours to Study Power

Before and after the World Power Conference delegates will visit some representative American power stations. This graphic insert gives a bird's-eye view of practice and developments as an orientation service to these distinguished guests.

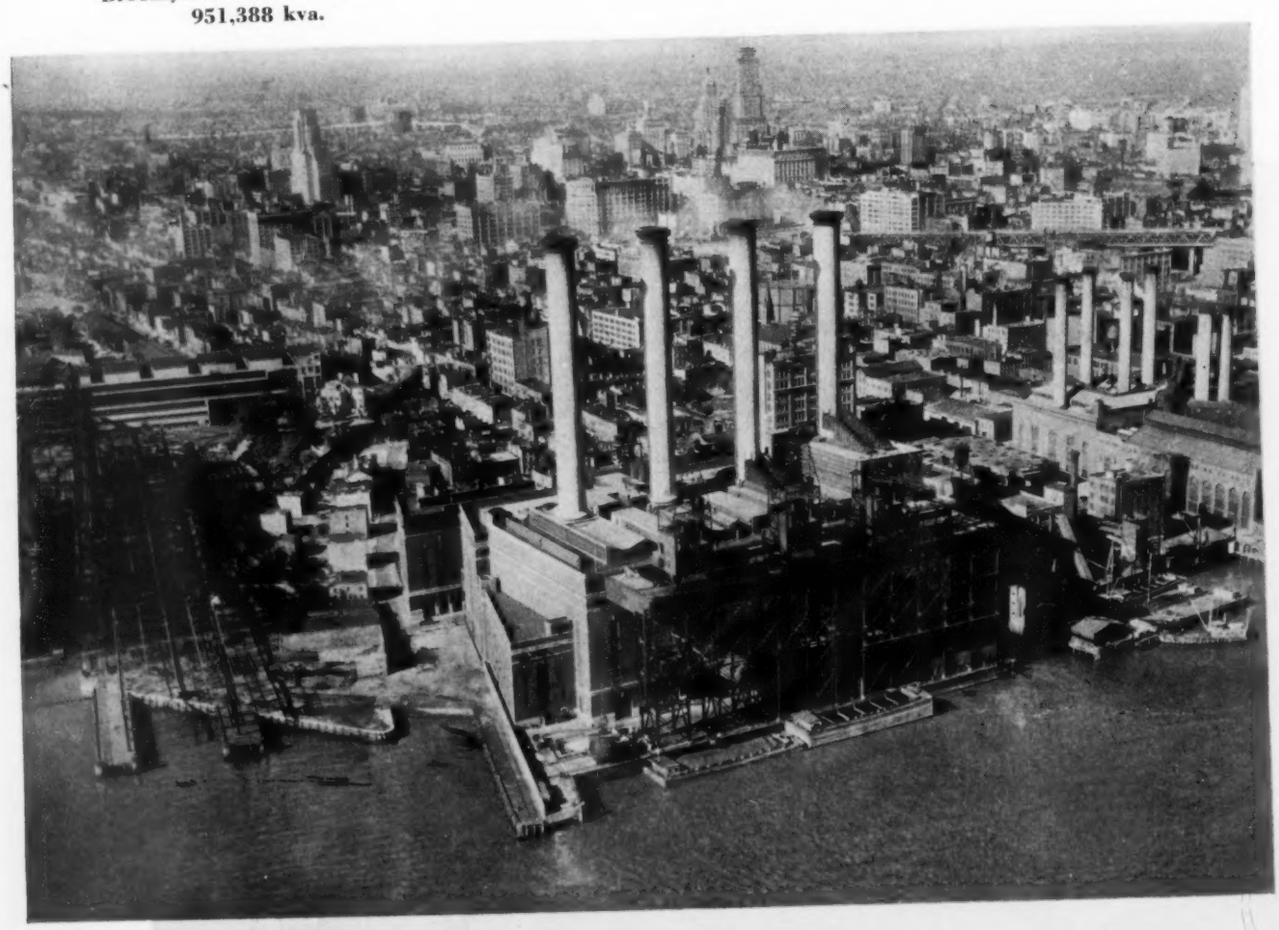
Richmond Steam Station
—unusual architecture
and one of the largest
power units

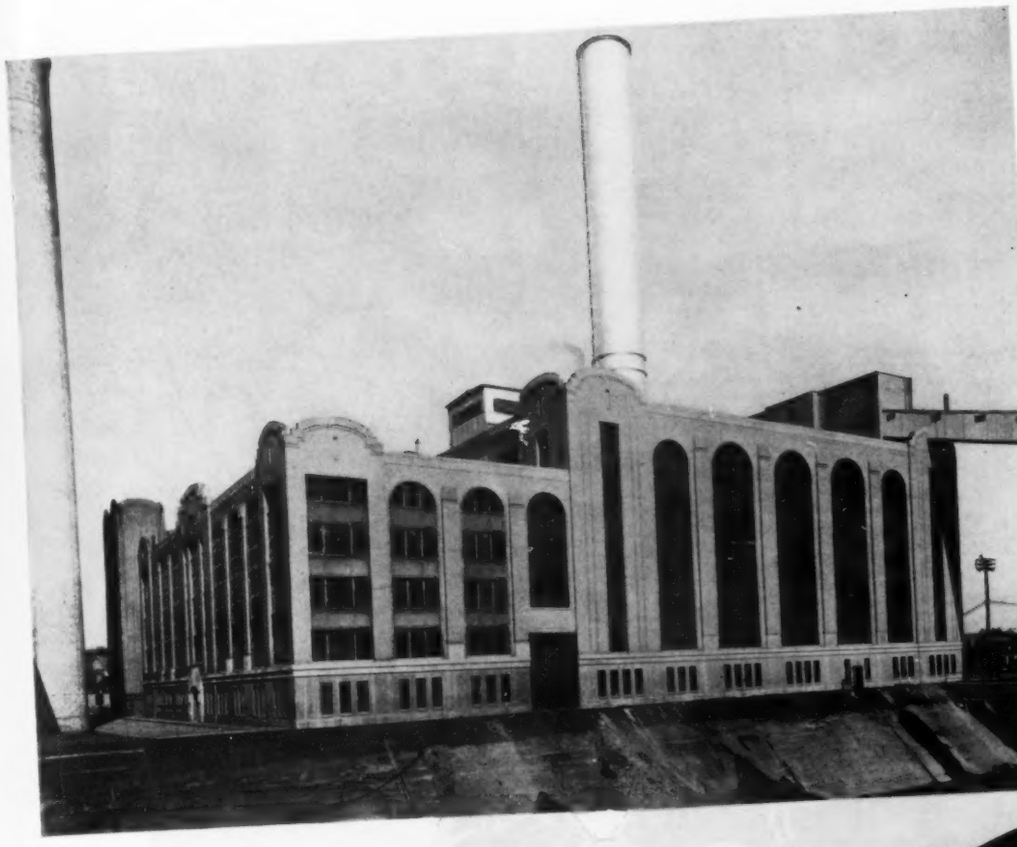
PLANTS TO SEE IN NEW YORK



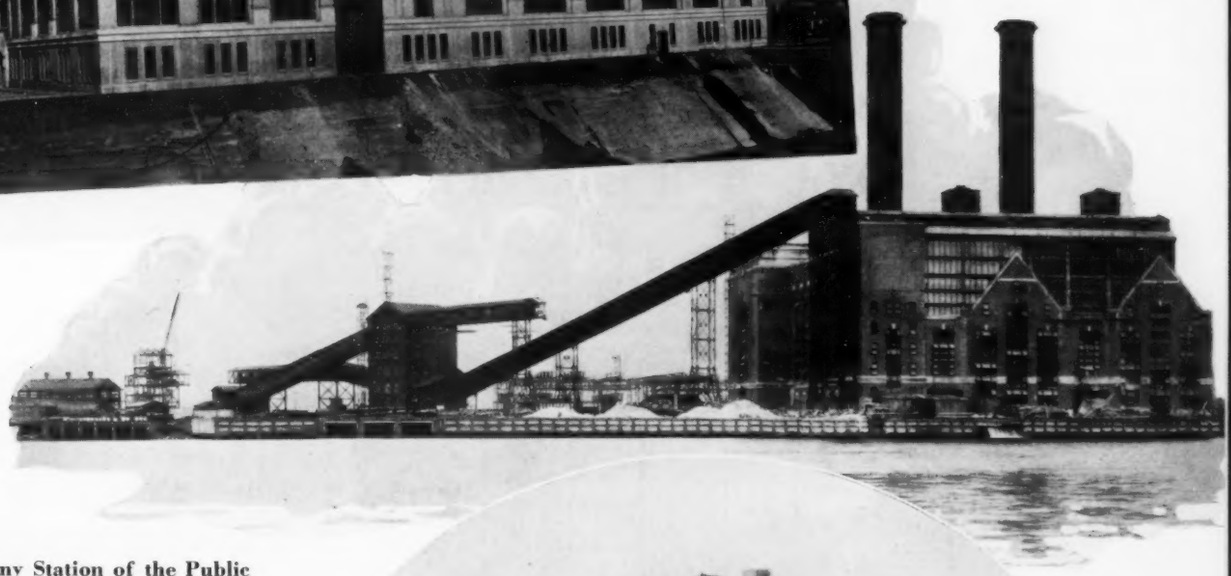
East River Station of the New York Edison Company, 280,000 kva.

Hudson Avenue Station of Brooklyn Edison Company, 951,388 kva.



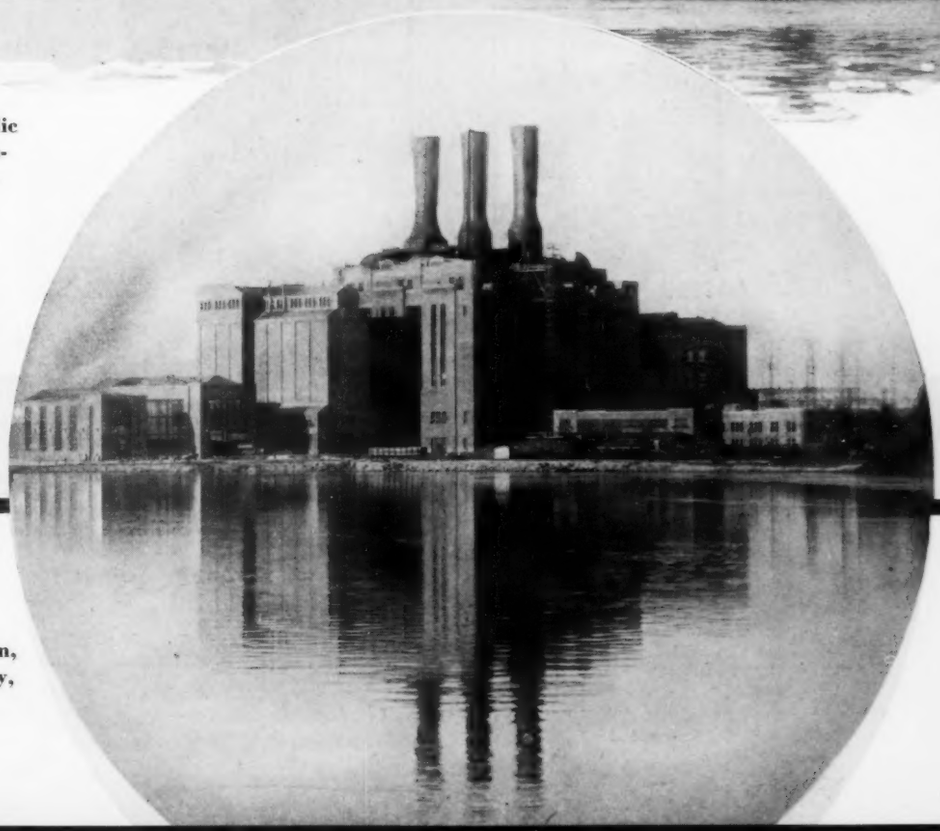


James H. Reed Station, Duquesne Light Company, Pittsburgh, 137,200 kva.

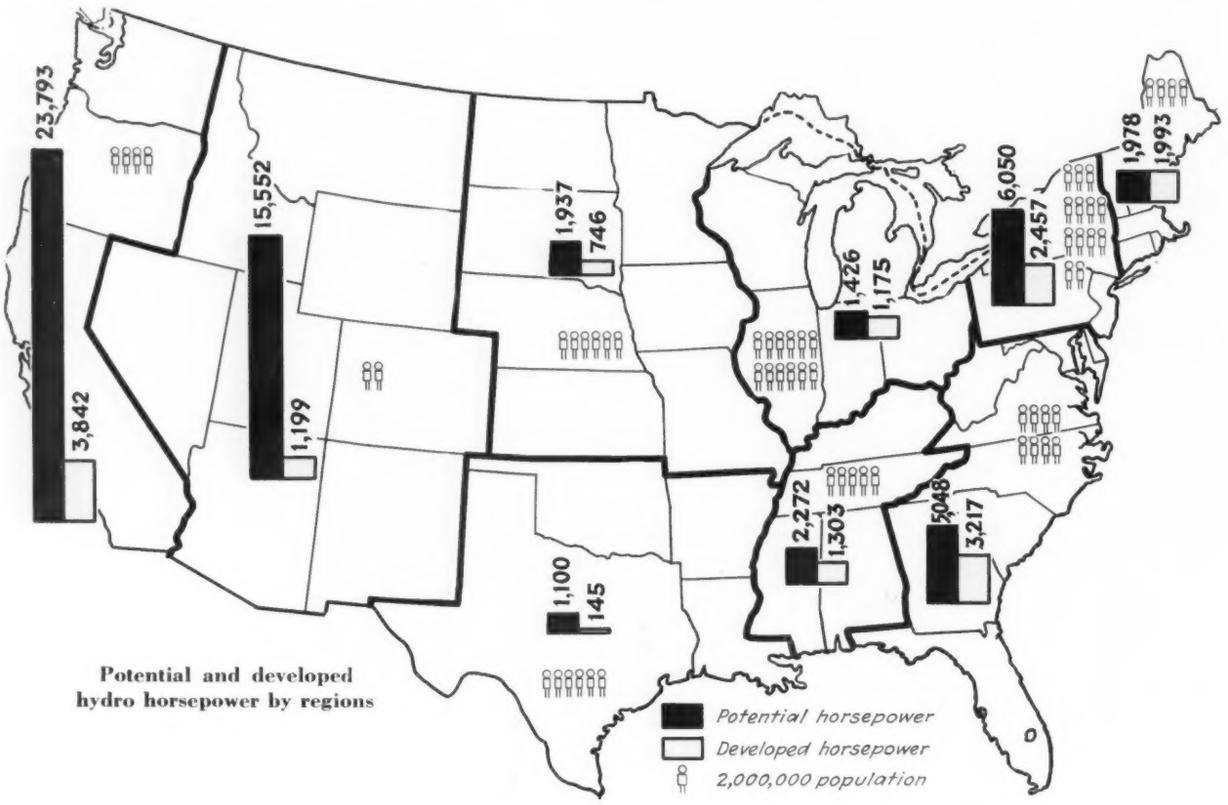


Kearny Station of the Public Service Electric & Gas Company, Kearny, 363,332 kw.

METROPOLITAN PLANTS TO VISIT



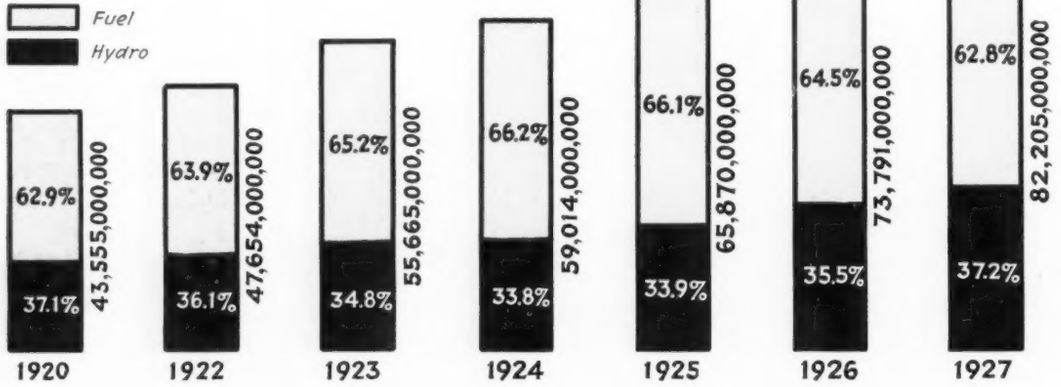
Trenton Channel Station, Detroit Edison Company, Detroit, 300,000 kw.



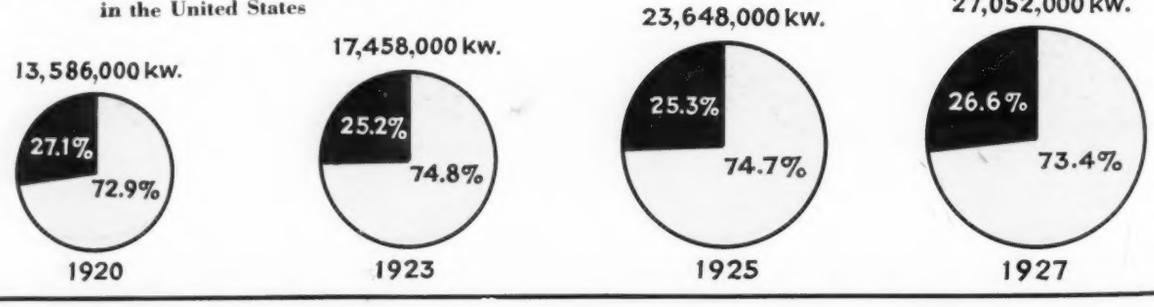
Potential and developed hydro horsepower by regions

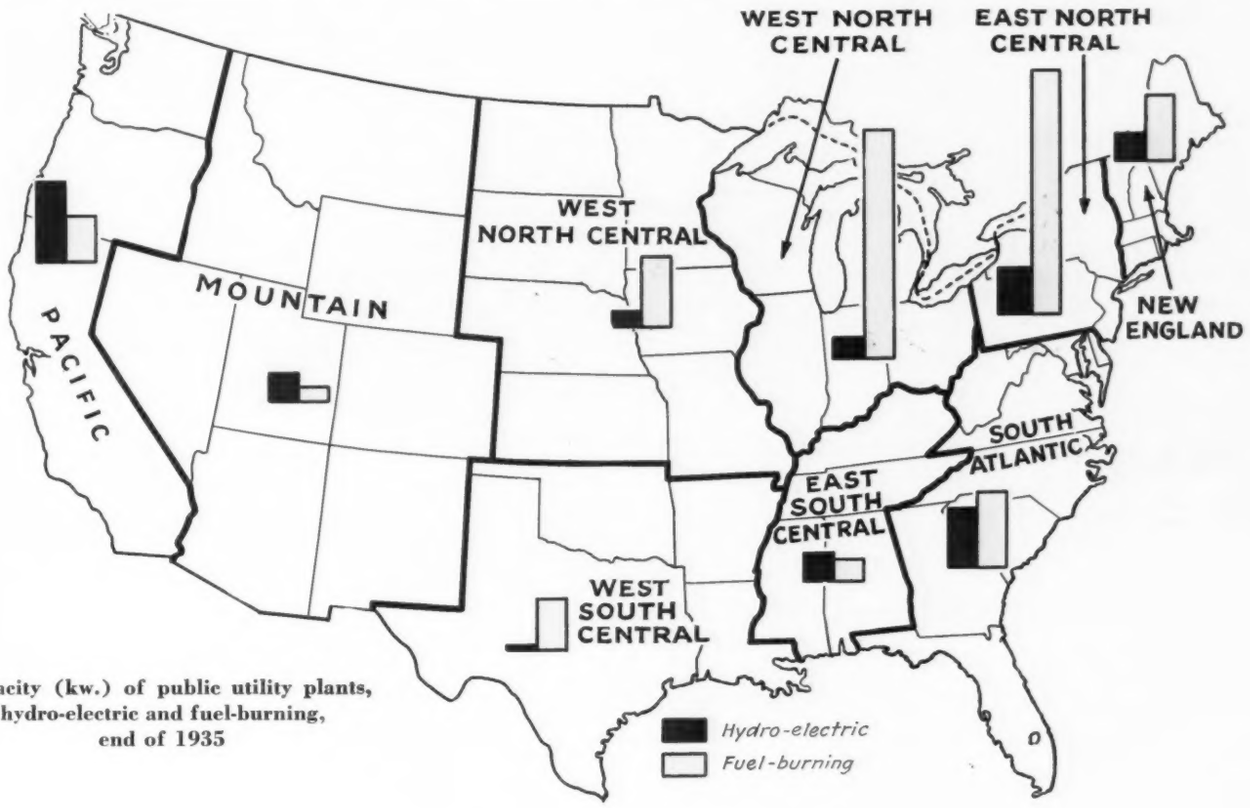
Growth of American Power Supply

Output (kw.-hr.) of public utility plants in the United States from fuels and water power, 1920-1935

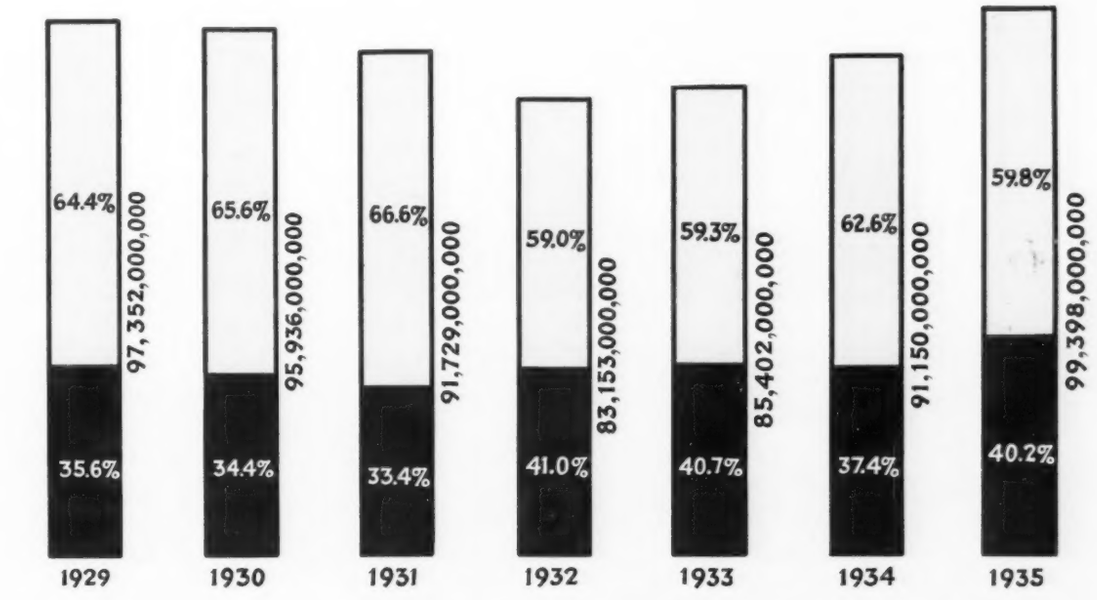


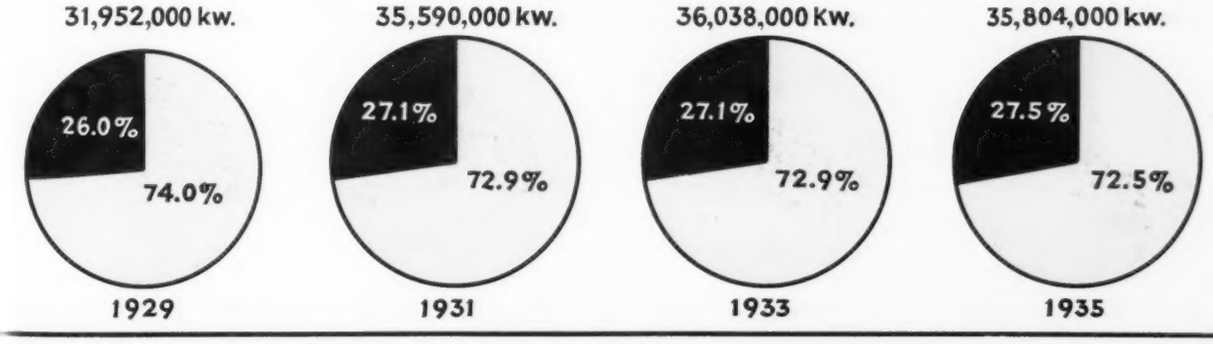
Growth of installed capacity in public utility plants in the United States





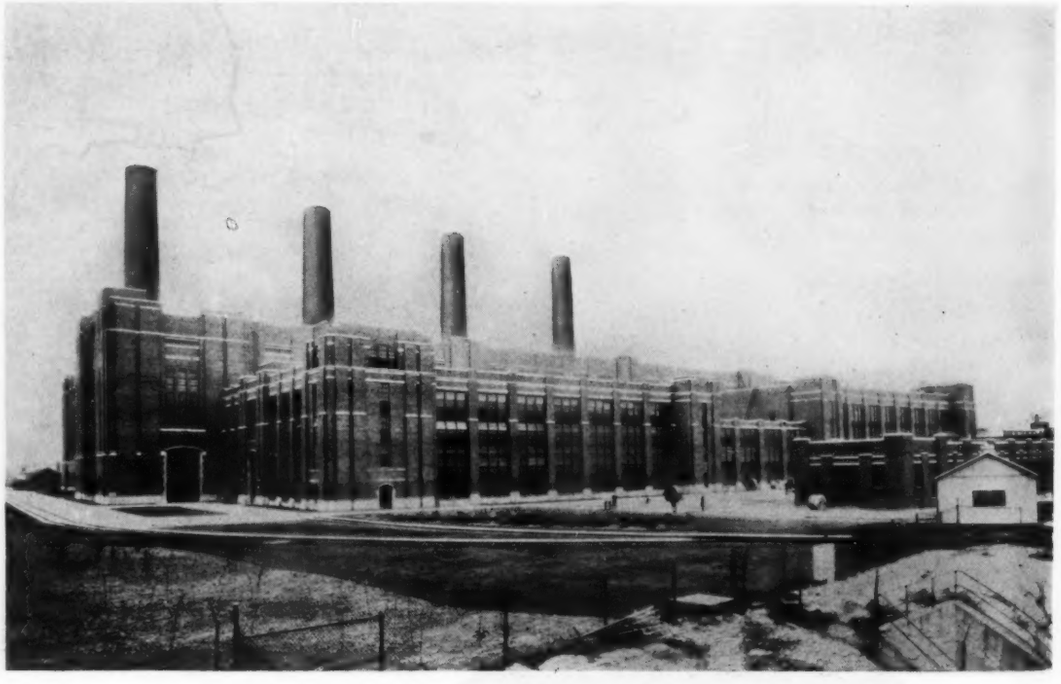
Capacity (kw.) of public utility plants, hydro-electric and fuel-burning, end of 1935





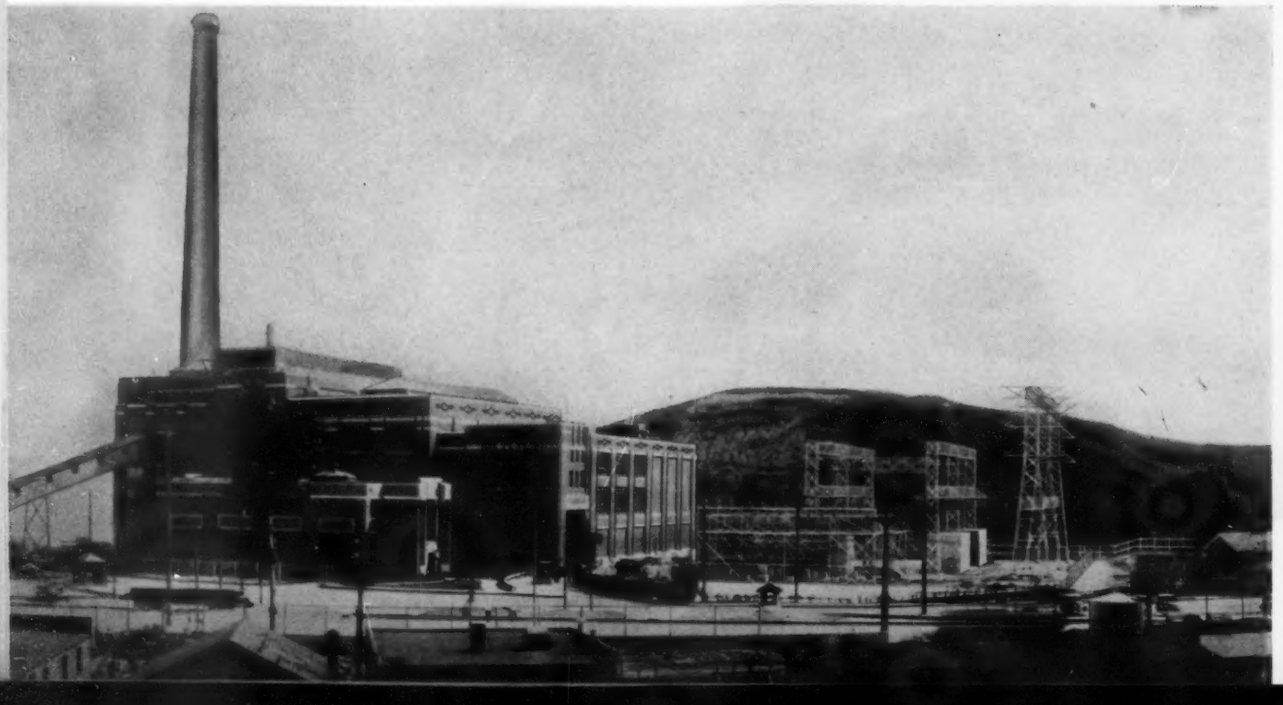
State Line Station, State Line Generating Company, Hammond, Ind., 208,000 kw.

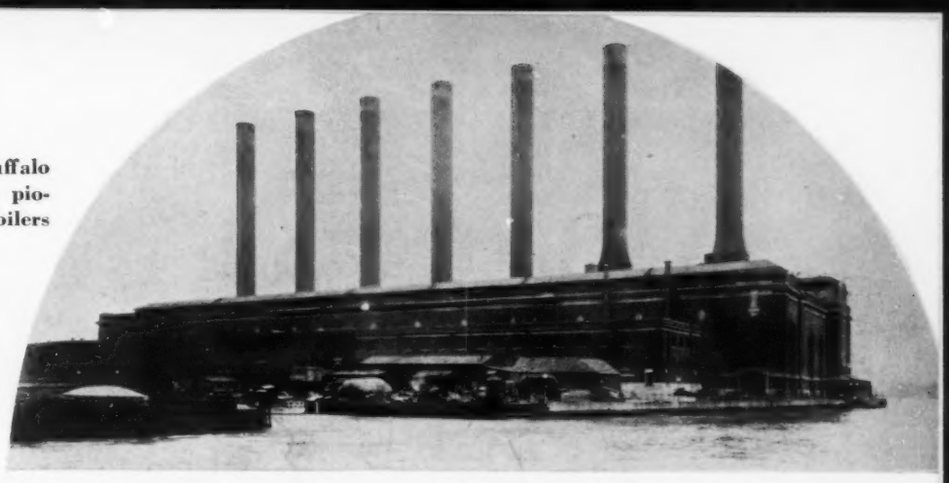
UNUSUAL MIDWEST PLANTS



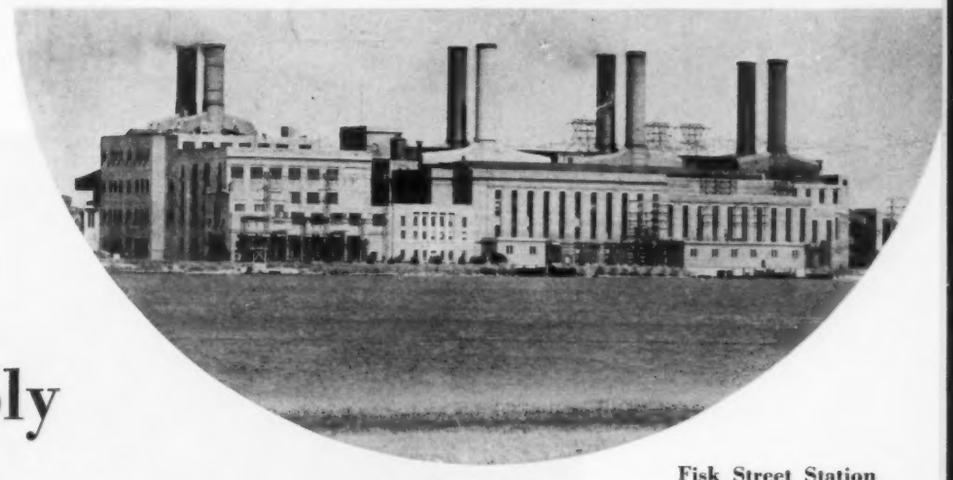
Crawford Avenue Station, Commonwealth Edison Company, Chicago, 424,000 kw.

Port Washington Station, Milwaukee Electric Railway & Light Co., 80,000 kw.





Huntley Station of the Buffalo General Electric Company pioneered with slag bottom boilers



Fisk Street Station of the Commonwealth Edison Company will have a superimposed unit installed

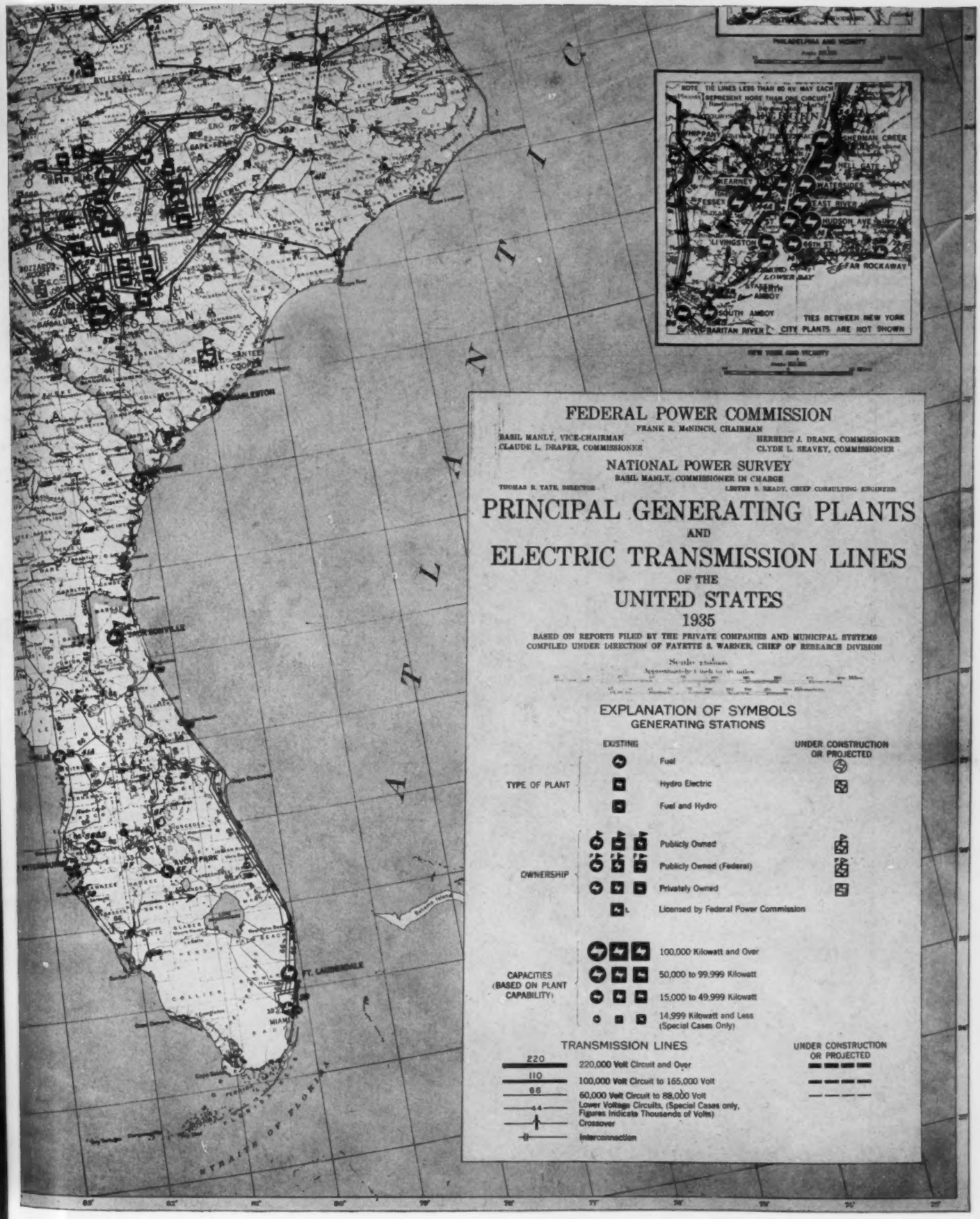
American Power Supply

American power supply has been built up of integrated units in each area that have been interconnected by transmission lines wherever this has been advantageous from an economic and service standpoint.

In each area the steam and hydro plants have been designed to fit into the entire power supply system for the area as well as for the utilization of diversity between load areas. What might be called the base generation and transmission structure for national power supply has been built. The present endeavor is to intensify loading and to utilize the maximum possible values from the existing installations.

In the accompanying maps, compiled and published by the Federal Power Commission, an idea is given of the magnitude and extent of our present electrical systems. No scale is adequate to portray details in such a large area with so many stations and lines. These maps and the illustrations showing modern plants, however, afford a basic picture of what has been done in this country in less than fifty years.

ARKANSAS
MISSISSIPPI
LOUISIANA
LITTLE ROCK
CARPENTER
STERLINGTON
MARKES
HECHES
ATKINSON
MARTIN
WAUKEGAN
NOTE: TIE LINES LESS THAN 69 KV MAY EACH REPRESENT MORE THAN ONE CIRCUIT
LAKE MICHIGAN
NORTHWEST
FISK ST
CRAWFORD
CALUMET
STATE LINE
BLUE ISLAND
EAST CHICAGO
JOLIET
PAGE
VENICE
CAHOKIA
NOTE: TIE LINES LESS THAN 69 KV MAY EACH REPRESENT MORE THAN ONE CIRCUIT



FEDERAL POWER COMMISSION

FRANK R. McNINCH, CHAIRMAN

BASIL MANLY, VICE-CHAIRMAN — HERBERT J. DRANE, COMMISSIONER

CLAUDE L. DRAPER, COMMISSIONER — CLYDE L. SEAVEY, COMMISSIONER

NATIONAL POWER SURVEY

BASIL MANLY, COMMISSIONER IN CHARGE

THOMAS R. TATE, DIRECTOR — LESTER S. READY, CHIEF CONSULTING ENGINEER

PRINCIPAL GENERATING PLANTS AND ELECTRIC TRANSMISSION LINES OF THE UNITED STATES 1935

BASED ON REPORTS FILED BY THE PRIVATE COMPANIES AND MUNICIPAL SYSTEMS
COMPILED UNDER DIRECTION OF FAYETTE B. WARNER, CHIEF OF RESEARCH DIVISION

Scale 250 miles
Approximately 1 inch to 4 miles

EXPLANATION OF SYMBOLS

GENERATING STATIONS

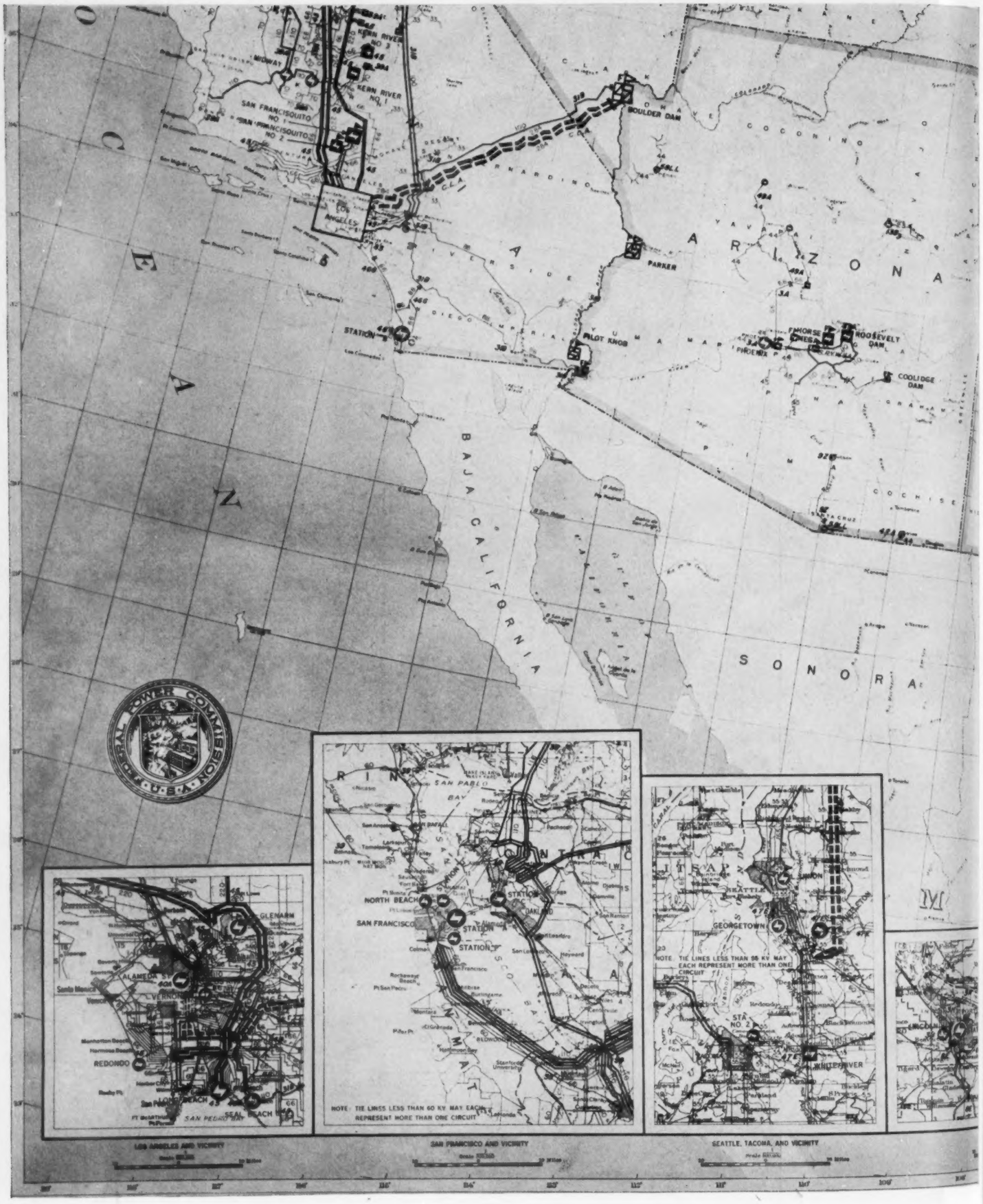
		EXISTING	UNDER CONSTRUCTION OR PROJECTED
TYPE OF PLANT	Fuel		
	Hydro Electric		
	Fuel and Hydro		
OWNERSHIP	Publicly Owned		
	Publicly Owned (Federal)		
	Privately Owned		
	Licensed by Federal Power Commission		
CAPACITIES (BASED ON PLANT CAPABILITY)	100,000 Kilowatt and Over		
	50,000 to 99,999 Kilowatt		
	15,000 to 49,999 Kilowatt		
	14,999 Kilowatt and Less (Special Cases Only)		

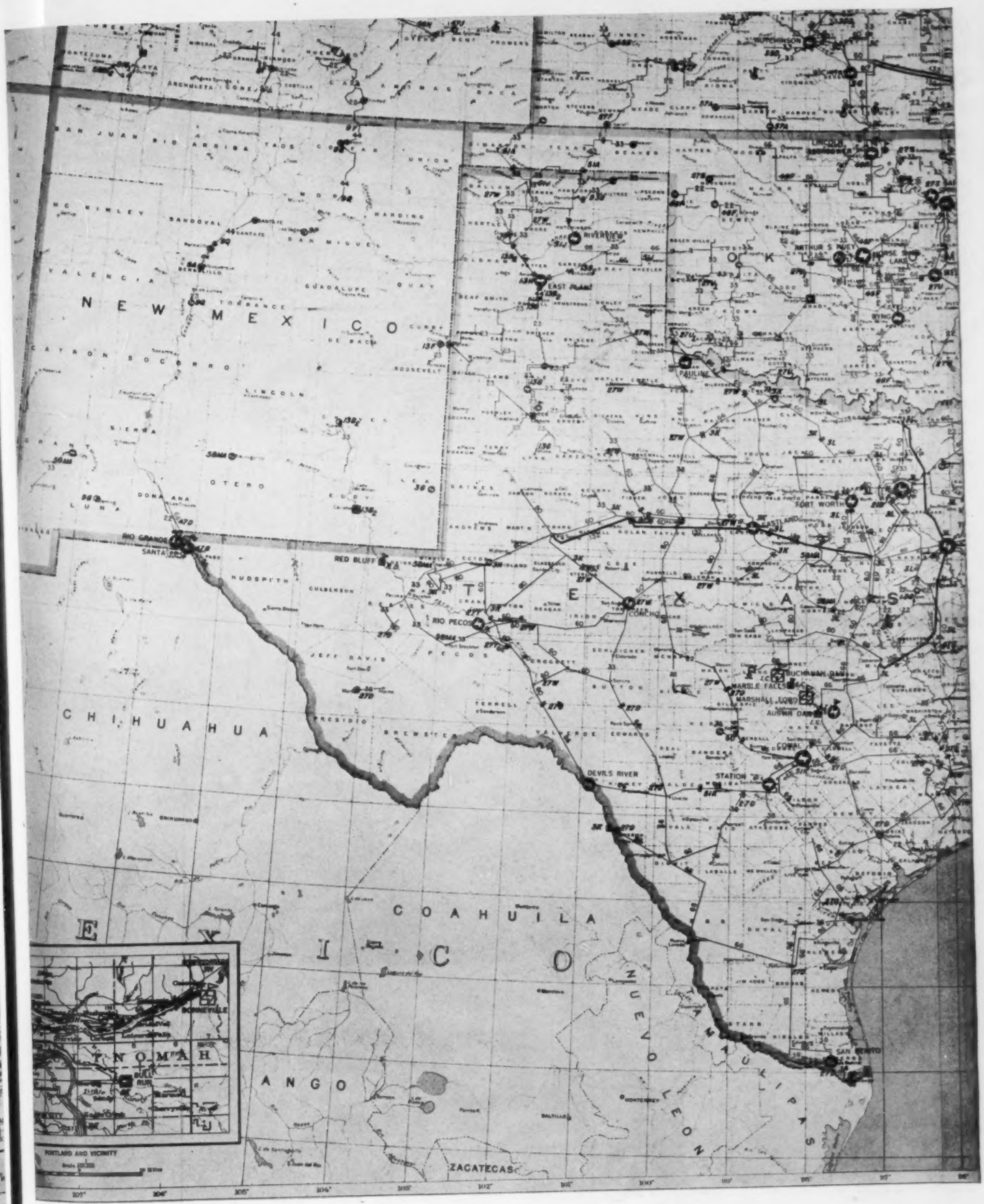
TRANSMISSION LINES

		UNDER CONSTRUCTION OR PROJECTED
220	220,000 Volt Circuit and Over	
110	100,000 Volt Circuit to 165,000 Volt	
66	60,000 Volt Circuit to 88,000 Volt	
44	Lower Voltage Circuits, (Special Cases only, Figures Indicate Thousands of Volts)	
	Crossover	
	Interconnection	

LAKE SUPERIOR
DETROIT AND VICINITY
BUFFALO AND VICI
HYDRO-ELECTRIC POWER
OF ONTARIO
TRENTON CHANNEL
CONNORS CREEK
MISTERSKY
ADAMS
HUNTLEY
BUTTALO
CHARLES W. TIPPY
MARYSVILLE
HIGH BRIDGE
DULUTH
DANVILLE
POWERS
KEOKUK
GRAND FALLS

BOSTON AND VICINITY
NOTE. THE LINES LESS THAN 60 KV. MAY EACH REPRESENT MORE THAN ONE CIRCUIT
SALEM
LYNN
WESTERN AVE
EDGAR
ATLANTIC OCEAN
NEW BRUNSWICK
NOVA SCOTIA
LAKE ONTARIO
HAWKS NEST
SCHUYLKILL


PACIFIC OCEAN
ARIZONA
SONORA
BAJA CALIFORNIA
KERN RIVER NO. 1
KERN RIVER NO. 3
SAN FRANCISQUITO NO. 1
SAN FRANCISQUITO NO. 2
MIDWAY
LOS ANGELES
BOULDER DAM
PARKER
PILOT KNOB
STATION
ROOSEVELT DAM
COOLIDGE DAM
PHOENIX
YAVAPAI
MARICOPA
PINAL
GILA
GRAHAM
COCHISE
COCONINO
MOHAVE
YUMA
RIVERSIDE
SAN BERNARDINO
SAN DIEGO
IMPERIAL
NORTH BEACH
SAN FRANCISCO
OAKLAND
SAN PABLO BAY
SAN MATEO
CONTRA COSTA
NOTE: TIE LINES LESS THAN 60 KV MAY EACH REPRESENT MORE THAN ONE CIRCUIT
GLENARM
ALAMEDA
REDONDO
SEAL BEACH
SAN PEDRO BAY
LOS ANGELES AND VICINITY
SAN FRANCISCO AND VICINITY
SEATTLE, TACOMA, AND VICINITY
ITSAP
SEATTLE
GEORGETOWN
NOTE: TIE LINES LESS THAN 66 KV MAY EACH REPRESENT MORE THAN ONE CIRCUIT
STA NO 2
SNOQUALMIE RIVER
FEDERAL POWER COMMISSION


NEW MEXICO
TEXAS
CHIHUAHUA
COAHUILA
ZACATECAS
RIO GRANDE
SANTA FE
RED BLUFF
RIO PECOS
DEVILS RIVER
FORT WORTH
SAN ANGELO
PAULINE
RIVERSIDE
EAST PLAINS
ARTHUR S NUEY
MARSHALL FORD
STATION
BONNEVILLE
PORTLAND AND VICINITY

BRITISH COLUMBIA
IDAHO
NEVADA
OREGON
PACIFIC
DIABLO
GRAND COULEE
LITTLE FALLS
LONG LAKE
THOMPSON FALLS
PORTLAND
STATION "C"
STATION "P"
PELTON
METOLIUS
PROSPECT NO. 1
COPCO NO. 1
COPCO NO. 2
KESWICK
KENNETT
PIT NO. 3
PIT NO. 1
COLEMAN
CARIBOU
BIG BEND
ELDORADO
TIGER CREEK
STANISLAUS
BALCH
AMERICAN FALLS
GRACE
CUTLER

SASKATCHEWAN
MANITOBA
MINNESOTA
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
WYOMING
COLORADO
KANSAS
MORONY
FORT PECK
SEMINOE
KEYSTONE
SUTHERLAND
LACOMBE

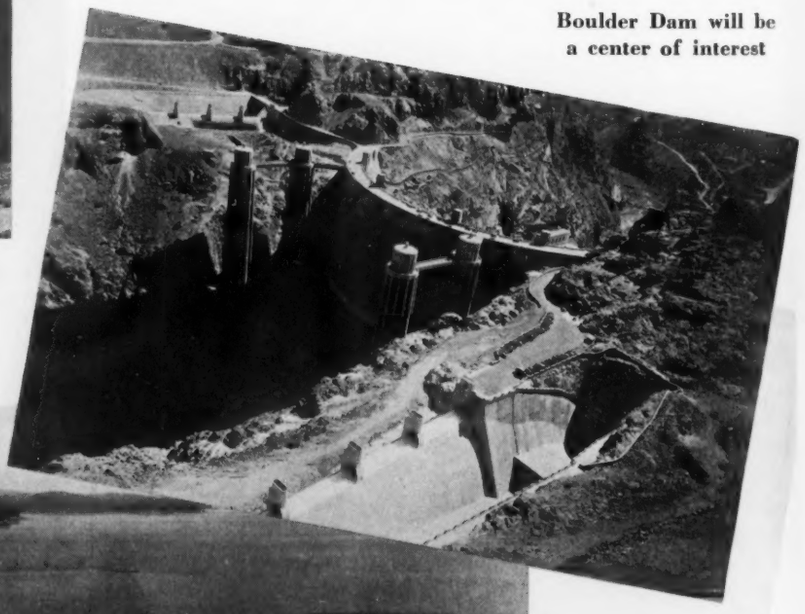
HYDRO PLANTS WILL INTEREST DELEGATES

Many of the visiting delegates expect to cross the continent to look over American hydro-electric practice and Western power developments

Safe Harbor is an interesting Eastern plant

Norris Dam is but one of the T.V.A. sites to visit

Boulder Dam will be a center of interest



Osage development should draw delegates to St. Louis

Load-Area Detroit Plants

Permanent Station Sites Economical—Use Standard Units and Layouts—Rebuilding Practiced—Separate Auxiliary Power Supply—Typical Station Performance

By P. W. THOMPSON
Chief Engineer of Power Plants, Detroit Edison Company

THE Detroit Edison Company operates in Detroit and the eastern portion of Michigan, serving more than half a million customers. Its generating facilities include four large steam-electric stations and eight small hydro-electric plants. The total capacity is 811,475 kw., of which only 9,550 kw. is water power. The principal business of the company has always been the supply of electric service, but in addition it provides a steam-heating service over a limited area from four steam-heating plants located in downtown Detroit and gas service in Port Huron and in towns located along the St. Clair River.

Numerous calculations have shown that for Detroit conditions steam-electric generation in or near the point of use where large amounts of condensing water are readily available is cheaper than would be the case were the generating stations located close to the source of fuel. Neither oil nor natural gas in quantities sufficiently large for power generation is commercially available in this part of Michigan, so coal is used exclusively. The economic balance of available heat in coal against cost of coal at the mine and freight rates has justified a preference for the high volatile bituminous coal from West Virginia and eastern Kentucky.

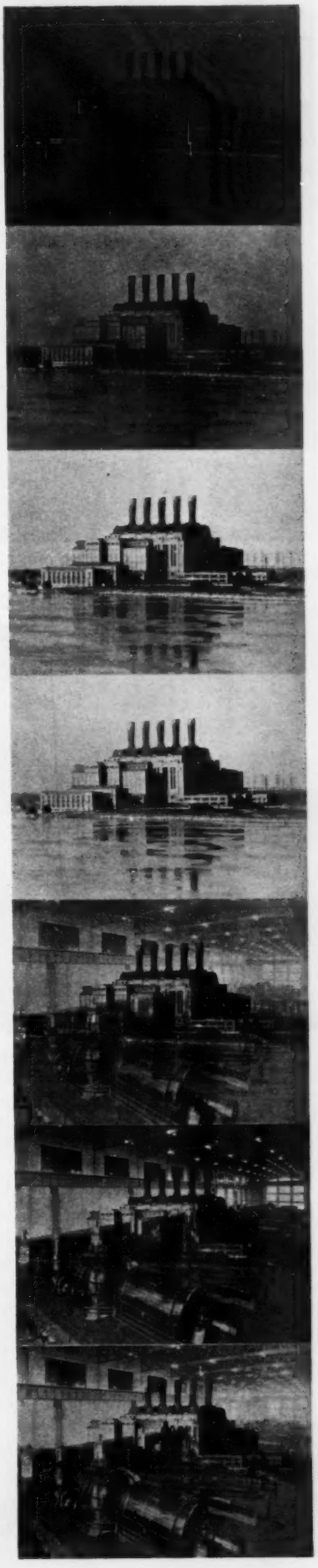
At all but one generating plant, where navigation facilities are inadequate, coal is delivered by boat from Lake Erie ports. Coal required during the period when navigation on the Great Lakes is closed is taken from a storage supply which is built up during the navigation season. It is customary to have in stock on November 30 at each plant receiving waterborne coal an amount sufficient to meet the fuel demand for at least the following four months.

Load-area stations

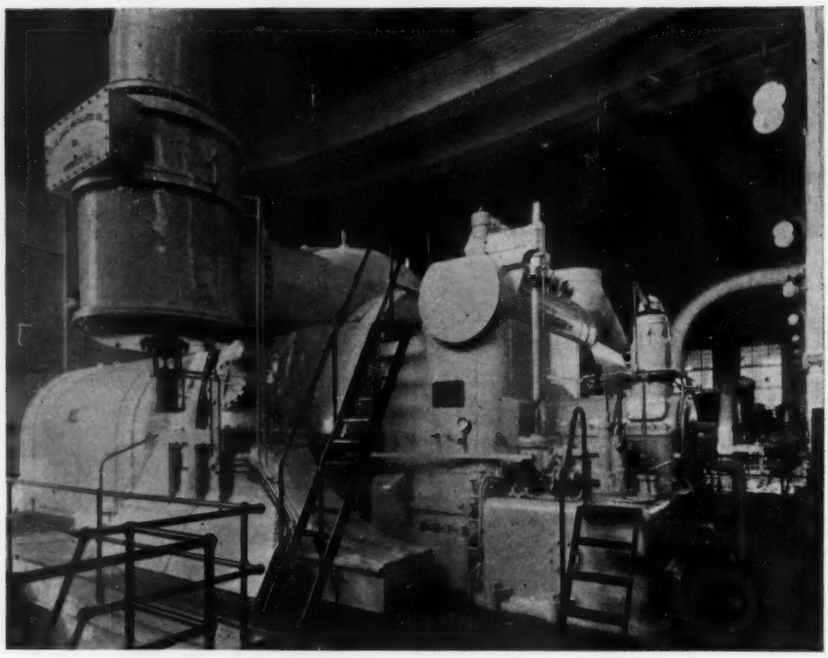
Each of the four plants, although interconnected electrically with the others, serves a definite load area. Sufficient running reserve is always carried so that the sudden loss of any turbine or major group of tie lines will not interrupt or adversely affect the service.

Conners Creek power plant represents at the same time both the oldest and the newest in design. Located 4½ miles east from the business center of Detroit, it serves a very important industrial area.

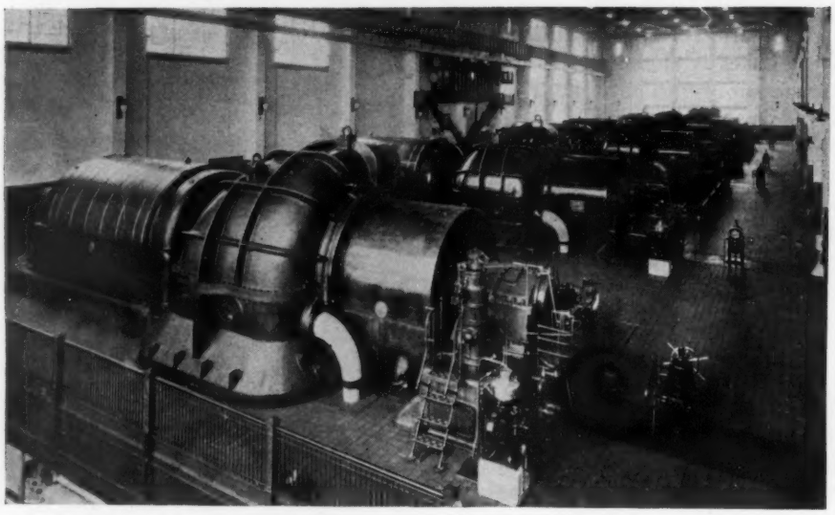
Construction of this plant was begun in 1913, and the first unit, a 20,000-kw. horizontal turbine and two boilers having a steam condition of 220 lb., 600 deg. F., went into operation in 1915. Additions of turbines and boilers were made until the plant capacity reached 180,000 kw. in 1920. Continued and increasing demand for electric service in the area supplied



Outside and inside of Trenton Channel



A rebuilt 30,000-kw. unit in Conners Creek



Six 50,000-kw. units at Trenton Channel

direct from Conners Creek and the obsolescence of the older plant equipment raised the question of the replacement and expansion of the plant facilities. Studies were made of how this might be accomplished and best serve the interests of both customers and stockholders. As a result of these studies and in the light of previous experience at Marysville, Trenton Channel and Delray power house No. 3 it was decided to modernize the plant rather than to build an entirely new one as at Delray.

Although further studies showed that an acceptable improvement in thermal efficiency could be expected by superposing high-pressure equipment on the old, this treatment of the problem had many disadvantages and lacked some of the advantages which could be realized by rebuilding the old plant. When the program of rebuilding, which is now well under way, including extension of the turbine room to accommodate two additional turbo-generators, is completed, the plant capacity will be 330,000 kw.

It was finally the decision of the management, based upon its best business judgment and supported by engineering analysis, to rebuild the old plant to include new high-pressure boilers, new turbines, heaters, etc. Service reliability, which is considered of first importance in the design of a power plant, is believed to be greater with the rebuilt plant than could have been expected had modernization been accomplished by superposition.

In this particular case considerable saving was effected by reusing certain parts of two old 30,000-kw. turbo-generators and three 20,000-kw. turbines in constructing the three new 30,000-kw. sets. Two 30,000-kw. generators were completely reused and the condensing equipment and foundations which served the three old 20,000-kw. units were reused with minor and inexpensive alterations, so that 50 per cent more capacity is now served than heretofore. This is considerably in excess of that which could have been obtained by superposition.

Use standard units

These three 30,000-kw. machines operating with steam at 600 lb., 825 deg. F. at the throttle are now in service, together with four boilers, three of which are sufficient to supply steam for full turbine load. These units are practically identical and all parts are interchangeable. It has always been a policy, in so far as is practicable, to duplicate equipment when making plant additions. For example, there are in Detroit ten 50,000-kw. turbo-generators located in three different plants and all are essentially duplicates and completely interchangeable with respect to parts. For these particular machines a complete spare turbine rotor is carried in stock so that turbine outage due to trouble with turbine wheels, buckets, packing, etc., is limited to the time required to remove the damaged rotor and replace the spare. Much time is thereby saved in making repairs. The record shows that this spare rotor has been in service approximately 60 per cent of the time since its acquisition in 1928.

There still remain the two 45,000-kw. machines of the old plant with six boilers, which may be ultimately replaced with two larger turbo-generators and their complement of boilers when still further capacity is needed. At present these 45,000-kw. units are operated only occasionally under particularly high plant load conditions or when one of the new units is not available.

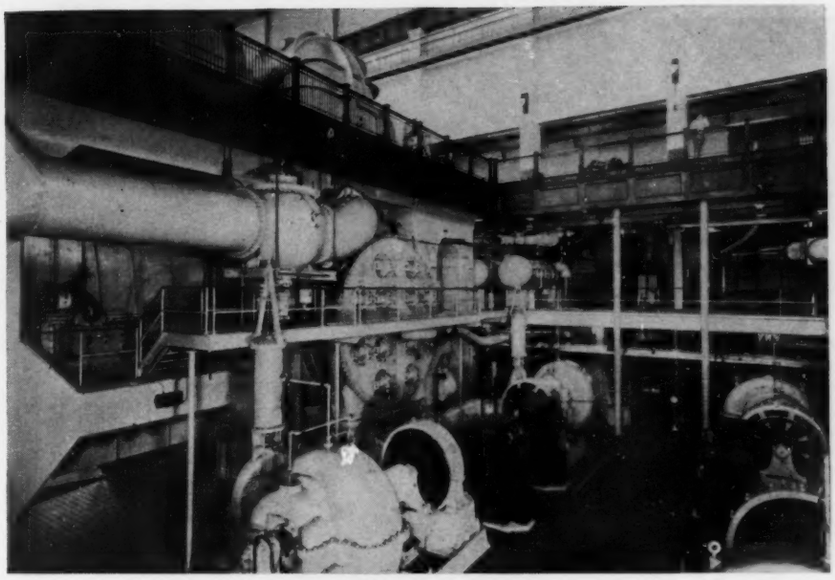
Two 60,000-kw. turbo-generators are to be placed in the addition recently made to the turbine room. One of these is in the process of erection and the other is being manufactured.

These two machines will operate on steam at the same temperature and pressure as the 30,000's and will be served by steam from four new high-pressure boilers.

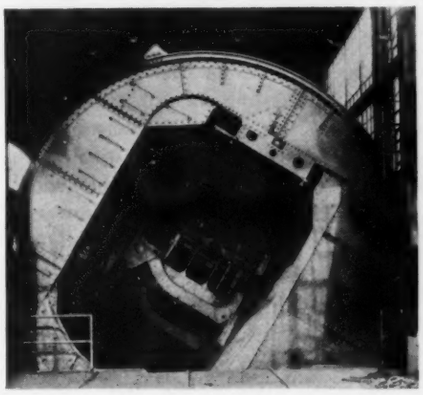
These boilers, as well as the four serving the 30,000-kw. turbo-generators, are identical. They are designed for 330,000 lb. of steam per hour, with 20 per cent overload capacity when burning on underfeed stokers, the ordinary run of coal. With a poor grade of coal, such as the plants might be required to burn under stress conditions such as prevailed during the World War, a continuous steaming rate of 330,000 lb. of steam per hour may reasonably be expected.

This size of steam-generating unit is almost identical with those installed in the company's other three plants. A unit of such capacity has been found by experience to give a good balance between size of turbine and size of boiler under the load conditions imposed. In the old plant boilers of approximately the same physical dimensions were used, but without economizers or air preheaters. Therefore, in adapting the new boilers with economizers and air preheaters, very little alteration to existing steel was required. The boiler-room roof was raised 17 ft. to accommodate forced- and induced-draft fans, but the space originally provided for economizers which were not installed in the old plant was sufficient to accommodate the economizers and preheaters of the new boilers. Change from the old to the new has increased the steaming rate per unit from 120,000 lb. to 330,000 lb. per hour and makes possible the installation of sufficient boiler capacity in the existing plant to serve the ultimate proposed generating capacity.

In designing the old plant, although its future rebuilding was not then contemplated, liberal space allowances were made in the structure for accommodating equipment. Prior experience at old Delray power houses Nos. 1 and 2, where insufficient space had been allowed, particularly around boilers, was the reason for adopting a more liberal policy in regard to the spacing of equipment. Such a policy has been followed in all subsequent power plant design. In the case of Conners Creek the rebuilding operations have resulted in an up-to-date plant with the higher capacity equipment conveniently arranged without crowding.



Condenser room in Delray



Car dumper unloads 75-ton cars

The so-called unit system of boiler and turbine is not applied. Cross-over piping is of such size as to permit the passage of the steam output from one boiler without excessive pressure drop. With such an arrangement one spare boiler serves the entire station.

Throughout the year 1935 both the old portion of the plant and one new 30,000-kw. turbo-generator were in operation. In prior years and under average load conditions the old plant produced a kilowatt-hour (average for year) for 19,000 B.t.u., so the figure of 14,110 for the year 1935 reflects the improvement realized from the operation of one new unit.

During the four months March to June, 1936, inclusive, sufficient new capacity had been installed so that the old section, with the exception of one boiler which was held under bank for immediate use if needed, was shut down. For this four-month period, including the coal burned in the banked boiler, the B.t.u. per kilowatt-hour of net output of the plant was 12,450, thermal efficiency on net output basis 27.4, over-all efficiency of steam-generating units 87.2 per cent.

Separate auxiliary power

At Conners Creek, as at the other Detroit Edison generating stations, an entirely separate auxiliary power system is provided to supply energy to station auxiliaries. The use of direct current as a source of supply for all auxiliaries, uninterrupted service of

Performance Data of Detroit Plants for 1935

	Conners Creek*	Delray No. 3	Trenton Channel	Marysville	Combined
B.t.u./kw.-hr. *net* output	14,110	14,130	13,990	14,190	14,070
Thermal efficiency, %, on net output basis	24.2	24.2	24.4	24.1	24.3
Efficiency of steam-generating units, %	83.5	83.6	87.1	86.5	85.6
Average daily load factor, %	81.4	73.5	63.2	72.0	70.1
Yearly load factor, %	49.8	44.0	48.3	54.5	51.6
Total *net* output, thousands of kw.-hr.	370,606	559,094	1,035,273	524,301	2,489,275
Station use in % of *net* output	4.8	4.2	4.5	3.5	4.3
Gross heating value of coal, B.t.u./lb.	13,220	13,520	13,530	13,400	13,450
Moisture in coal, %	5.62	4.27	4.23	5.10	4.64
Ash in dry coal, %	7.7	6.9	6.6	6.8	6.9
Year first in service	1915 / 1934	1929	1924	1922	....
Nominal steam conditions, Pressure, lb. gage	220 600	375	375	275	....
Temperature, deg. F.	600 825	725	725	700	....

*Figures show the combined performance of the old low-pressure plant and one new 30,000-kw. high-pressure turbo-generator.

Operating floor for new Conners Creek boiler

which is essential to the continuous operation of main generating equipment, has long been a practice of the Detroit Edison Company.

To be entirely separate from the main generating system, auxiliary d.c. generators are provided. These are driven through reducing gears by their own separate steam turbines exhausting to their own condensers. The source of power for essential auxiliaries is therefore completely separated electrically from the main station bus and is not in any way affected by electrical system disturbances.

Cost of providing and operating such a system is sometimes questioned on the score of its cost as compared to an alternating-current system. If cost were the only consideration, an alternating-current system would present a slightly more favorable showing. Other considerations, however, such as better reliability, its adaptability to adjustable-speed drive, simplicity of operation, ease of maintenance and safety to men working on or around energized circuits, have been considered as of more importance than the matter of investment cost differential.

To be sure, simple alternating-current circuits deriving their energy from the main station bus are used for general building lighting, operation of coal-handling equipment, etc., but the uninterrupted output of the main generating equipment is not dependent upon their continuous operation.

Principles of design

Design of power plants of the Detroit Edison Company is carried on under the supervision of the operating department heads. New plant projects are so organized that those charged with the responsibility for operation and maintenance and who are to have similar responsibilities over the new facilities exercise a directive control over the entire design. Although all decisions with respect to any project are made by one individual, they reflect the operators' viewpoint.

This type of design organization insures wholehearted acceptance of the project in its many details by those who later become charged with its operation, and by these means those things which the operating force considers important in the continuous performance of their duties are duly considered.

These policies have been followed for the past twenty-odd years and experience has proved that the results have justified the means. The plants of the Detroit Edison System are of reasonable efficiency, of a high degree of reliability and are designed to make operation easier, surer and more convenient. Advantages of the latter lie in the fact that there is a close approximation between results which are obtained on test and those obtained year in and year out.

946,000 Kw. in New Capacity

Plans that have taken the form of orders show a large increment addition to generating capacity in 1936. Since the first of January a total of 946,000 kw. of generating capacity has been ordered, as shown in the accompanying table.

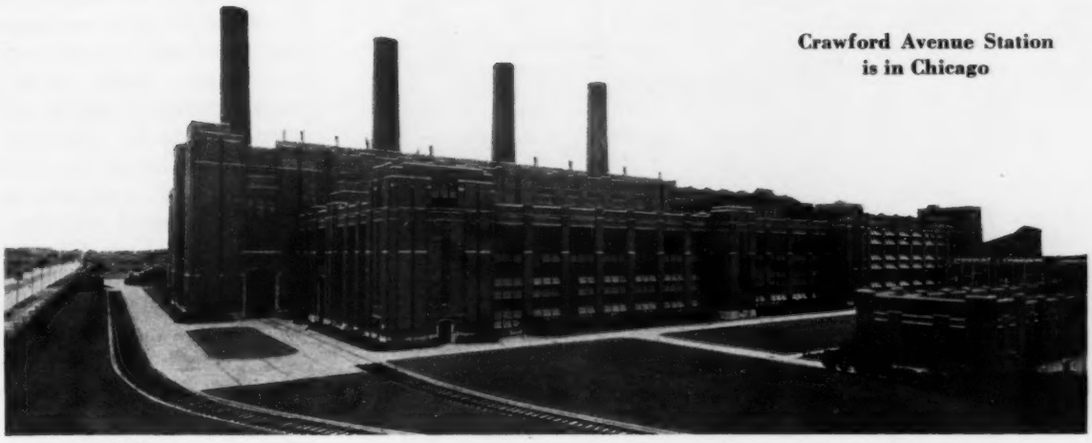
Many other small orders have been placed and negotiations are now active for several large units. It is estimated that about 1,500,000 kw. of capacity will be ordered this year, not including federal hydro projects in this summation.

Plans for Replacing or Adding Generating Capacity

Announced Since January 1, 1936

Company	Station	Kw.
Philadelphia Electric	Schuylkill	20,000
Public Service of N. J.	Essex	25,000
Connecticut Light & Pwr.	Montville	25,000
United Illuminating	New Haven	5,000
Lynn Gas & Electric	Lynn	25,000
Holyoke Water Power	Holyoke	17,500
Dayton Power & Light	Dayton	42,000*
Smith Mountain Power	Smith Mtn., Va.	30,000†
Laclede P. & L.	St. Louis	.....
Union Gas & Elec	West End, Cinc'ti.	30,000
Utah Power & Light	Provo, Utah	15,000
Potomac Electric Pwr.	Washington	30,000
Commonwealth Edison	Fisk Street	30,000
Detroit Edison	Trenton Channel	50,000
New York Edison	New York	50,000
St. Joseph R., L. H. & P.	St. Joseph, Mo.	7,500
Indianapolis P. & L.	.....	2,000
Fort Pierce, Fla.	.....	2,500
Greenwood, Miss.	.....	3,500
Sanitary District	Chicago	8,000
Virginia El. & Pwr.	Richmond	10,000
American Gas & Elec	Logan Plant	40,000
Public Serv. of Colo.	Valmont	34,000*
Nebraska Power	Omaha, Neb.	10,000
West Penn. Power	Springdale	50,000
Virginia Pub. Serv.	Alexandria, Va.	....
Eastern Shore Pub. Serv.	Salisbury, Md.	1,000
Iowa-Nebraska P. & L.	Red Oak, Iowa	2,500
Northern States Pwr.	Minot, N. D.	....
United Power Mfg.	Iowana, Iowa	‡28,000
Keystone Public Serv.	Oil City, Pa.	5,000
Monongahela West Penn Pub. Service	Rivesville	25,000
Consumers Power	Battle Creek, Mich.	10,000
Potomac Edison	Amcelle	10,000
Savannah Elec. & Pwr.	Riverside	7,500
Ohio Power-West Penn.	Windsor	120,000
Kansas City, Mo.	.....	30,000
Detroit Edison	Conners Creek	60,000
Union El. Lt. & Pwr.	Cahobria	75,000

*Horsepower. †Horsepower hydro. ‡Kva.



Crawford Avenue Station is in Chicago

Power for Chicago District

An Integrated Supply System for 4,000 Square Miles—Peak of 1,250,000 Kw. and Output of 5,553,302,000—Details of Capacity, Interconnection and Operation

By ALEX D. BAILEY
Chief Operating Engineer, Commonwealth Edison Company

THE so-called Chicago District, including the 213 square miles in the city of Chicago, comprises an area of about 4,000 square miles in the northeastern part of the State of Illinois and the northwestern part of the State of Indiana. Commonwealth Edison Company, which is the largest organization in the group of companies supplying this territory, supplies electricity in the city of Chicago and the Public Service Company of Northern Illinois supplies the suburban area in Illinois. A portion of the Illinois territory is also supplied by the Western United Gas & Electric Company. The Northern Indiana Public Service Company alone supplies the area in the State of Indiana. Each company maintains a certain amount of generating capacity in its own system.

In addition, two large generating companies, the Chicago District Electric Generating Company, with its State Line station, and the Super-Power Company of Illinois, with its Powerton station, supply electrical energy to other companies in the group; State Line to the Commonwealth Edison and the Northern Indiana companies and Powerton to the utility companies in Illinois. In addition, the Northern Indiana Public Service Company interchanges power with the American Gas & Electric Company's System to the east, through its connection at Michigan City.

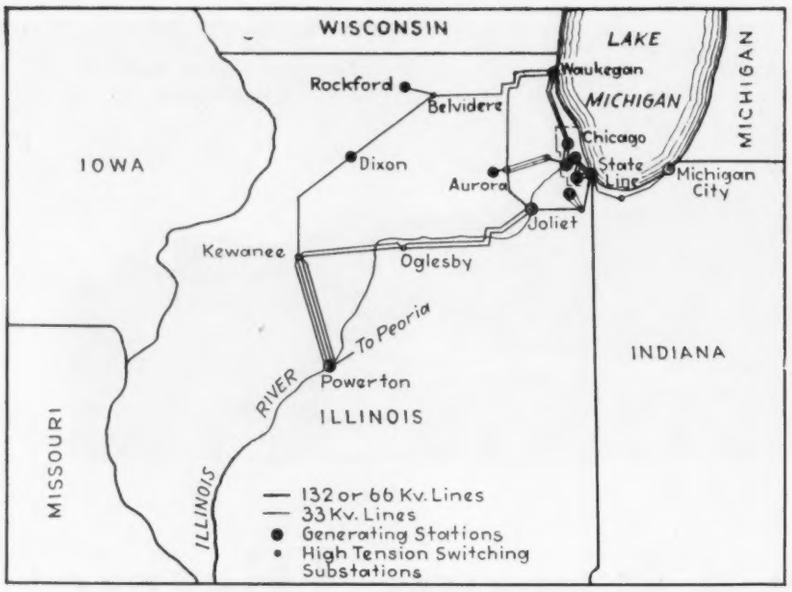
The coincident peak in the Chicago District last winter was 1,250,000 kw. and the output for the year 1935 was 5,553,302,000 kw.-hr., of which approximately 4,200,000,000 kw.-hr. was used in the city of Chicago.

Within the city the Commonwealth Edison Company generates and distributes both 25-cycle and 60-cycle energy, the former at 9 kv. and the latter at 12 kv. The 25-cycle system supplies a part of the central section of the city, which is served by an Edison d.c. system, and also supplies the larger part of the energy for the elevated and street railway systems. Peak load on the 25-cycle system is about 250,000 kw. The 60-cycle system, which supplies the remainder of the service, by far the larger part, has a peak of about 750,000 kw.

No additions have been made to the company's generating capacity within the city since 1928, because at that time the government was considering a reduction in the amount of water which was being taken from Lake Michigan through the Chicago and Calumet Rivers, on which the company's stations are located. Because of the uncertainty of an adequate amount of circulating water, it was necessary for the company to look elsewhere for additional power supply, and arrangements were made to purchase energy from stations outside of the city.

State Line for bulk power

Just outside of Chicago, in the State of Indiana, at the lower end of Lake Michigan, is the State Line station of the Chicago District Electric Generating Corporation. Practically all of the energy generated at this station is delivered to the Commonwealth Edison Company, a relatively small amount being supplied to the North-



Chicago district power supply

ern Indiana Public Service Company, which has a modern generating station of 60,000 kw. capacity at Michigan City, Ind., as well as some small hydro plants in Indiana. About 35 miles north of Chicago, on the shore of Lake Michigan, is the Waukegan station of the Public Service Company of Northern Illinois, which delivers a part of its generated energy to the Commonwealth Edison Company's system from the north, and a smaller station southwest of Chicago, belonging to the same company, supplies energy over the tie lines from the south. About 160 miles southwest of the city, on the Illinois River, is the Powerton station of the Super-Power Company of Illinois, which supplies the greatest portion of its output to Commonwealth Edison Company and Public Service Company of Northern Illinois. The supply to Chicago comes either by way of the Waukegan station or over the tie lines through Joliet.

The transmission system supplying energy from Powerton and Waukegan, as well as the system east of State Line station, is overhead and is operated at 132 kv., 60 cycles. That part of the transmission system which connects with Waukegan station and which is within the city limits is necessarily underground. Transmission lines connecting State Line station, as well as those between the company's stations in the city, are operated at 66 kv., 60 cycles.

Stations previously mentioned are all large, modern and efficient. State Line station operates at a steam pressure of 660 lb. and 730 deg. F. temperature. There are in operation at present six boilers, fired with pulverized coal and natural gas, about one-half each, and a 200,000-kw. cross-compound, three-unit, turbine-generator set. Additional boilers are being installed, which will operate at 1,250 lb. steam pressure and 825 deg. F. temperature, connected to a 150,000-kw. single-shaft turbine-generator. Waukegan station has five turbine-generator units, varying in size from 25,000 kw. to 115,000 kw. The first two units operate at 350 lb. steam pressure and 640 deg. F. temperature, while the newer, larger units operate at 625 lb. steam pressure and 750 deg. F. temperature. Boilers in the older section of the station are fired with forced-draft chain grates and in the newer section with pulverized coal. Powerton station is equipped with nine boilers, fired with pulverized coal and operating at a steam pressure of 650 lb. and 725 deg. F. temperature. There are three turbine-generator units, two of 52,500 kw. capacity and one of 105,000 kw. The performance of these stations varies from less than 12,800 B.t.u. per kilowatt-hour for Powerton station to approximately 13,300 B.t.u. per kilowatt-hour for Michigan City.

Crawford Station—This is the largest and most modern of the company-owned stations. It was put in service in 1924 and the last unit was installed in 1928. Located on the south branch of the Chicago River at Pulaski Road, it consists of six cross-compound turbine units and 32 boilers fired with forced-draft chain grate stokers. Steam pressure is 625 lb. and temperature 725 deg. F. Steam for units 1, 2 and 3 is reheated in special boilers to 700 deg. F. and that for units 5 and 6 is reheated with live steam to 560 deg. F. Unit 4 has no reheat. The turbine units range in size from 50,000 to 100,000 kw. Boilers are fitted with water-cooled furnaces—some partially and some completely cooled—also with economizers and air preheaters. This station delivered more than 2,000,000,000 kw.-hr. in 1929 and again in 1930, and during a single month has produced 206,000,000 kw.-hr. The output for this year will be approximately 1,750,000,000 kw.-hr. Station performance is about 14,600 B.t.u. per net kilowatt-hour.

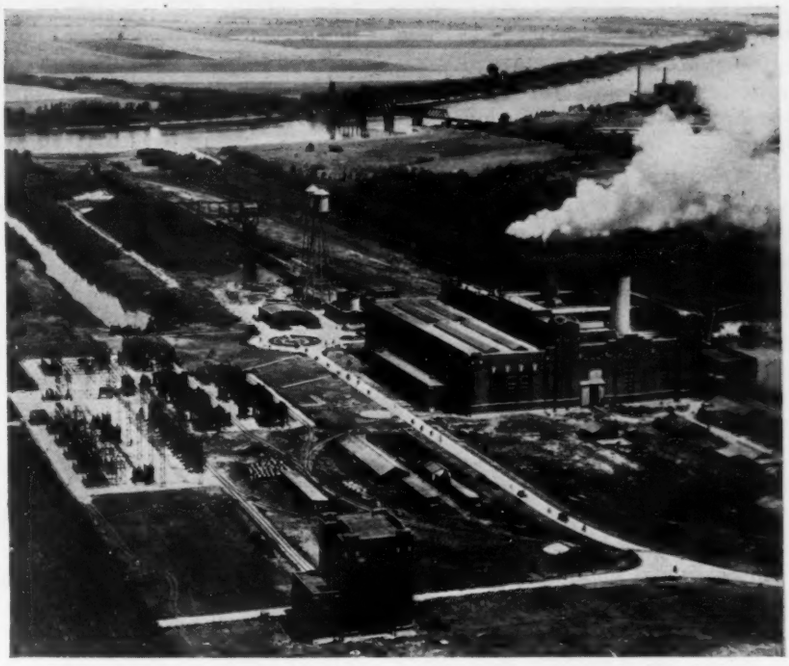
Calumet Station—This station was put into operation in 1921 and is located on the Calumet River at East 100th Street, in the southeast section of the city. It consists of six turbine units and twenty boilers. Five of the turbine units are of 30,000 kw. capacity and the sixth 37,500 kw. Eighteen of the boilers are fired with forced-draft chain grates and are equipped with economizers and air preheaters. Steam pressure is 325 lb. and the temperature 650 deg. F. There are two special boilers which were installed to try out pulverized coal firing. For the past two or three years this station was shut down, except for intermittent operation in cases of emergency, but it was put into regular operation last December, with two units operating regularly five days per week. Three of the boilers were fitted for burning natural gas and the station operates on dump gas except in the extremely cold weather, when it is necessary to revert to coal because gas is not available. Station performance is about 18,000 B.t.u. per net kilowatt-hour. During the coming winter it will be necessary to operate four units in this station five days per week.

Northwest Station—This station was started in 1912 and is located at Roscoe Street and North California Avenue on the north branch of the Chicago River and at the north end of the city. The first two units installed were 20,000-kw. vertical units, followed later by a 35,000-kw. and a

30,000-kw., 25-cycle horizontal units and later by two 30,000-kw., 60-cycle units. One of the vertical units is 60 cycle and the other 25 cycle. The three 25-cycle units in this station operate regularly six days per week and the 60-cycle units are brought in for peaks or for emergencies. Boilers in this station are fired with chain grates, some of them equipped with forced draft. The newer boilers are equipped with economizers. Steam pressure is 250 lb. and the temperature 600 deg. F.

Fisk Street Station—This station, located on South Fisk Street and on the south branch of the Chicago River, is the oldest of the stations and in many ways the most interesting. In it the first 5,000-kw. General Electric turbine was installed, in 1903. This was immediately followed by two others, and in 1905 by a larger turbine having an ultimate capacity of about 7,500 kw. The original units were each supplied with steam from a row of eight Babcock & Wilcox boilers fired with natural-draft chain grates.

Beginning with 1906, six larger turbines were installed, with an ultimate capacity of 12,000 kw. each, but served by the same number of boilers with the same size grates. The stacks, however, were 50 ft. higher, to give additional draft. In 1908 and 1909 the first four units were removed and replaced with 12,000-kw. vertical units, similar to the six previously described. All ten of these units generate 25-cycle energy at 9 kv. Steam pressure is 200 lb. and the temperature 510 deg. F.



Chicago Aerial Survey

Powerton operates at less than 12,800 B.t.u.

In 1914 a 25,000-kw. Parsons horizontal turbine-generator and a 20,000-kw. horizontal General Electric unit were put into service, the former being a 25-cycle machine and the latter a 60-cycle. These were followed later, in 1919, by a 35,000-kw., 25-cycle unit and a 30,000-kw., 60-cycle unit. Sixteen larger boilers, equipped with natural-draft chain grates and with economizers, supplied steam to the four large units. The chain grates on two of the units were later changed to forced draft. Steam pressure is 220 lb. and the temperature 550 deg. F.

This station, which is nearest to the center of load and in the most strategic position, operated at full load over the winter peaks for several years, and the 25-cycle Parsons unit held the record for high capacity factor over a long period of its operation. As newer and more efficient stations were built, however, and as a result of the installation at Fisk Street station of two 40,000-kw. frequency-changers for supplying 25-cycle system energy from the more efficient generating units in the newer stations, the load on this station was decreased, although four of the old vertical units and the two 25-cycle horizontal units continue in regular operation and the two 60-cycle units are used for peaks and in emergencies.

Waukegan station interconnects with Chicago

Fisk to have superposition

A new chapter in the history of Fisk Street station is just beginning. Two of the units of old boilers have been removed and in their place will be installed two boilers fired with pulverized coal, each of which will deliver a maximum of 412,500 lb. of steam per hour at 1,275 lb. pressure and 900 to 910 deg. F. temperature. The furnaces will be completely water-cooled, of the slag-bottom type, with continuous slag removal. They will have selec-

tive control of the gas travel in order to maintain constant steam temperature and will be equipped with economizers, air preheaters and Cottrell precipitators for collecting fly ash in the flue gas.

Steam from these boilers will be used in a 30,000-kw., 25-cycle superposed turbine-generator set, which will exhaust at a constant pressure of 220 lb. and a temperature of approximately 540 deg. F. into the existing steam header supplying the four large turbines now in service. Normally, the superposed turbine and the two 25-cycle turbines will be operated as a unit and will carry the base load of the 25-cycle system.

In preparation for the installation of the superposed unit the two 25-cycle horizontal units have been completely overhauled; the low-pressure turbine clearances have been restored by boring the cylinders and lining them with bronze and monel strips, the blading has been repaired or replaced where necessary, additional bleed points for heating the feedwater have been installed and the condensers have been entirely rebuilt.

Coal used in all the company's stations and most of that used in the stations of the associated companies comes from Central Illinois and has a heat value of slightly more than 10,000 B.t.u. per pound. It is delivered by railway cars, although provision is being made to transport a part of the Crawford station supply by water, by way of the Illinois River and the Sanitary Canal. The natural gas used at State Line and Calumet stations is brought by pipe line from northern Texas.

In order to effect the most economical operation of the system as a whole and at the same time assure reliability of service, the distribution of load between the various generating stations is worked out in advance for given system loads and schedules are prepared allocating to each station a definite load which it should carry under any and all conditions of system loads. In each station is a totalizing wattmeter, which continuously shows the load on the system, and by referring to this and to the loading schedule the operator controls the load on the particular station in which he is located. The load dispatcher's office, which is the central operating office for the system, follows loading conditions continuously, and in addition to its other duties makes daily estimates of morning and evening peak loads so that the stations will be prepared to take care of system requirements.

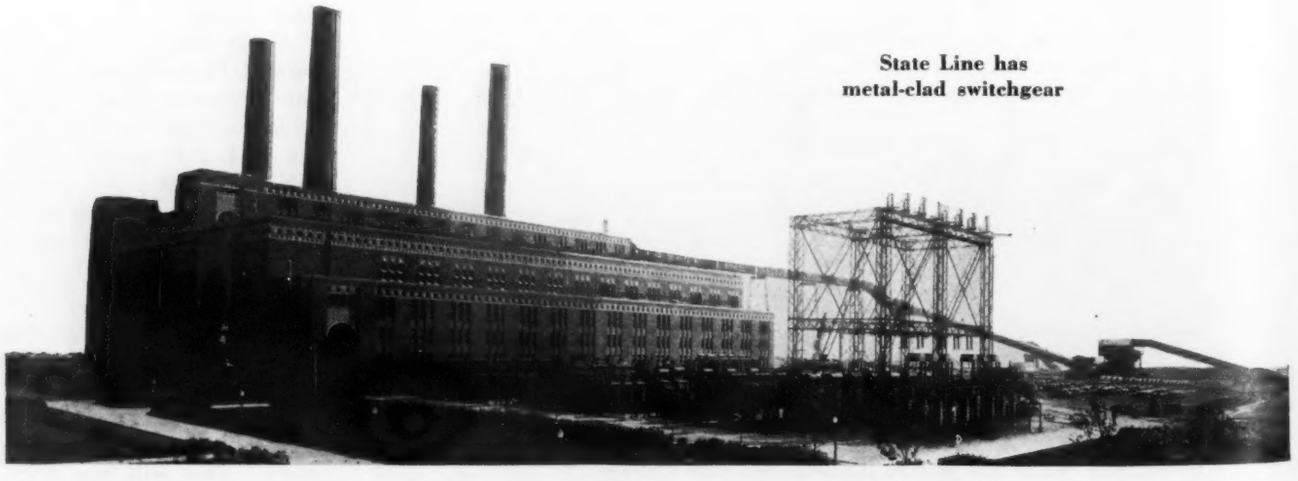
Adequate reserves kept

In order to assure the reliability of the service, an excess of capacity is kept in operation sufficient to take care of the interruption of the largest individual source of power on the system. This running reserve is likewise allocated to the various generating stations, both within the city and outside, depending somewhat on the load carried.

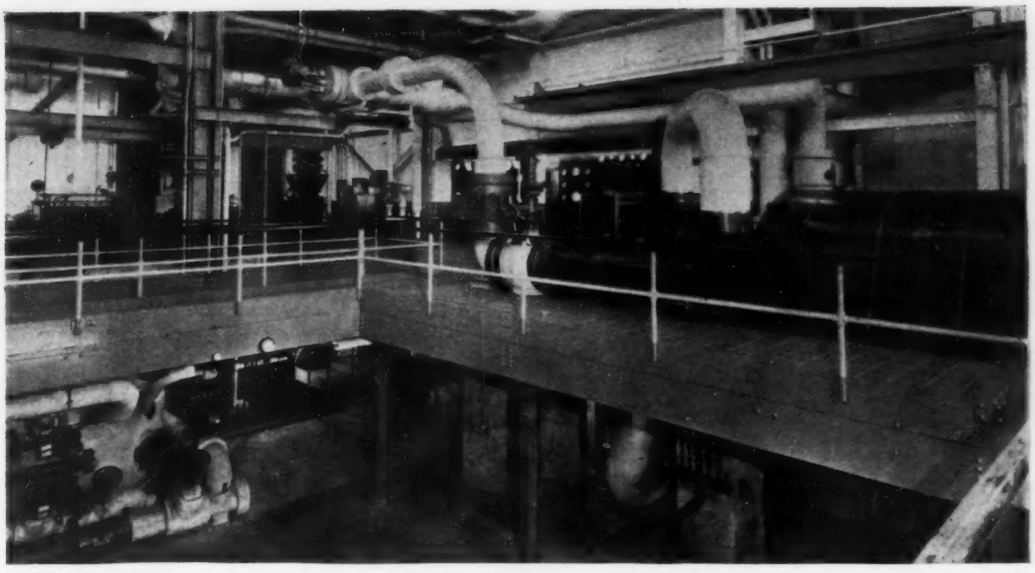
Lines from the various generating stations supply substations at various parts of the city, where the voltage is reduced for local distribution. For the d.c. district and railway service there is both 25- and 60-cycle supply, the older substations being equipped with rotary converters and the newer installations with mercury-arc rectifiers. In those parts of the system supplied with alternating current the transformation is more simply accomplished with transformer substations. An a.c. network has been started and is being expanded along the border of the present d.c. territory, and in this manner increases in load in the central section of the city are being taken care of without increasing the amount of 25-cycle generation and d.c. supply.

In the southeast section of the city, midway between Fisk Street and Calumet generating stations, a distributing center has been built which is supplied from the 66-kv. transmission system and which acts as the center for 12-kv. distribution to the surrounding substations, as well as for local distribution. A similar distributing center on the northwest side of the city, between Crawford and Northwest stations, will go into service this fall. The station at 25th and Quarry Streets, across the river from Fisk Street station, has been discontinued as a generating center and now is used only for distribution to loads in this area.

Distribution from the substations in the a.c. district is at 4,000-2,300 volts, which is in turn stepped down for domestic and commercial customers. Large power customers, however, may be supplied either from the stations directly or from the substations with 12-kv. energy supplying transformer vaults which they themselves own. There are 72 attended substations, 63 unattended substations and 233 customers' vaults, in addition to the substations owned and operated by the street and elevated railway companies.



State Line has metal-clad switchgear



Turbine addition in Rochester plant

Rochester Superposed Plant

6,000-Kw. High-Pressure Unit Added to Old 65,000-Kw. Plant—650-Lb. Turbine Exhausts at 210—Installation and Performance Data

By I. G. McCHESNEY . . . L. R. SCOTT
Rochester Gas & Electric Corporation

IN 1935 an increase of steam-generating capacity was required to meet electric peaks on the Rochester system and some replacement of old boiler equipment was needed. A superimposed high-pressure boiler and turbine was considered the most favorable solution to the problem. Generating capacity was increased at improved plant economy without writing off existing low-pressure turbines and generators. The E. M. Gilbert Engineering Corporation acted as consulting engineer in the design of the new high-pressure plant.

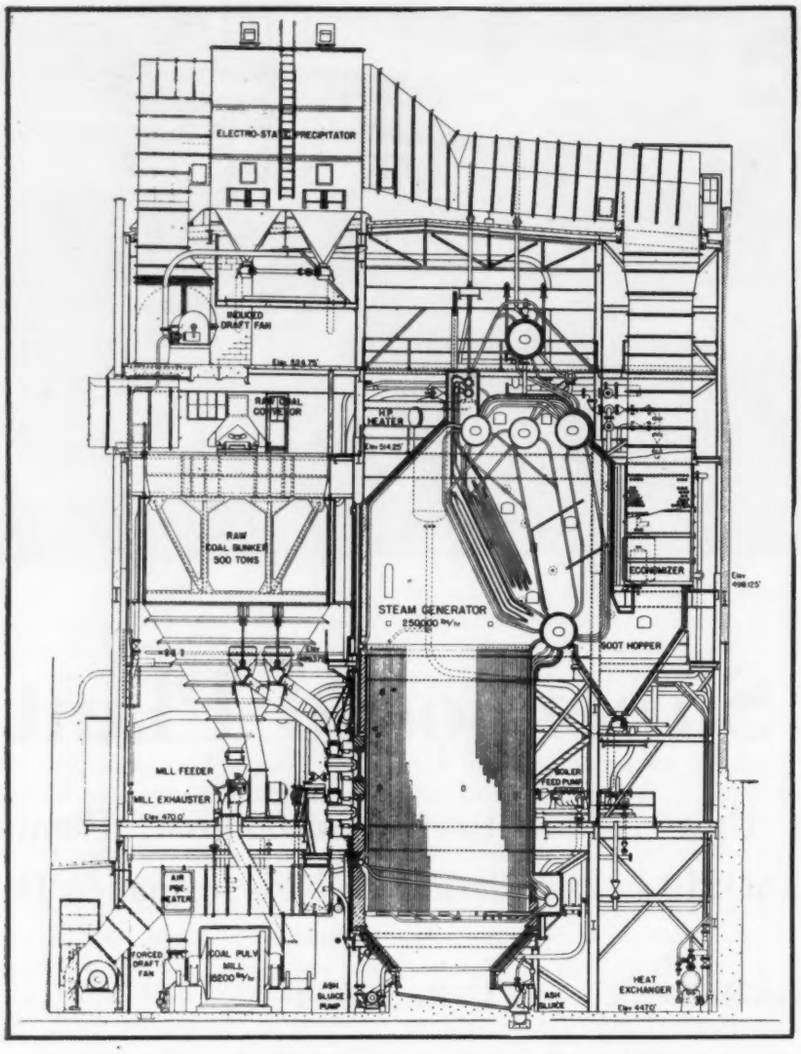
Station No. 3 is the main steam generating station of the system. The old plant has a generating capacity of 65,000 kw., consisting of one 7,500-kw., three 10,000-kw., one 12,500-kw. and one 15,000-kw. machines. Steam is supplied at 200 lb. and 500 deg. F. from twenty boilers. These boilers were installed at intervals from 1898 to 1919. The first of the present low-pressure turbines was installed in 1912. The last 15,000-kw. machine was installed in 1923. All the turbines are served with jet condensers using cooling water from the Genesee River.

Steam conditions of the low-pressure turbines and estimated performance of the high-pressure turbine fixed the high-pressure throttle conditions at 650 lb. per square inch and 750 deg. F.

Station No. 3 serves several large commercial steam customers in addition to electric generation. Very little condensate is recovered. In the high-pressure plant approximately 90 per cent make-up feedwater is required. The difficult problem of preparing this large make-up requirement from Genesee River water has been successfully solved under the guidance of Sheppard T. Powell.

Low-pressure bleed heating was not considered in the first installation. The feedwater entering the new plant is heated in batches by restricting the circulating water to the jet condensers of the 15,000-kw. turbine and pumping the entire condenser discharge to storage for intervals of one-half hour duration. The average water temperature entering

The first high-pressure extension at station No. 3 of the Rochester Gas & Electric Corporation was put into operation in January, 1936. In the plant 250,000 lb. of 650-lb., 750-deg. F. steam is supplied by a pulverized fuel-fired bent-tube boiler to a 6,000-kw. high-pressure turbine. The turbine exhausts at 210 lb. and 530 deg. F. to low-pressure turbines.



Cross-section of plant showing arrangement of high-pressure boiler and plant equipment

the high-pressure plant can be regulated to 100 deg. F. by this method of intermittent heating.

Heat from plant auxiliaries and boiler blowdown is added in a deaerating heater with further additions in a closed heater and economizer. Feedwater enters the economizer at 220 deg. F. and is heated to 345 deg. F. before being pumped to the boiler. This heating requires a large economizer with a surface equal to 90 per cent of the heating surface of the boiler.

General arrangement of the boiler room equipment is shown in the accompanying illustration with raw coal storage of 500 tons over the coal preparation and firing equipment. Two 7½-ton ball mill pulverizers are each served by an exhauster fan which carries coal and primary air to four burners in the front wall of the furnace. Approximately 69,000 cu.ft. of secondary air is supplied at full load by the forced-draft fan.

The boiler requires 11 tons of fuel per hour with full load on the high-pressure turbine. Maximum design output of the boiler is 250,000 lb. of steam per hour.

An electrostatic precipitator is used for dust removal.

The turbine generates 6,000 kw. at full load. Steam entering the throttle is at 750 deg. F. and 650 lb. per square inch pressure. Exhaust from the turbine at full load requires some desuperheating before entering the low-pressure mains. At light loads and when a portion or all of the steam by-passes the turbine a considerable amount of desuperheating is required. A desuperheater of ample capacity for all conditions of load is installed to give a constant output of steam at a temperature of 525 deg. F.

Plant Economy and Heat Cycle—Thermal characteristics of the plant are based on the condition that all steam from the high-pressure turbine is used for generation in the low-pressure turbines. In actual operation some steam from the high-pressure turbine is used in the low-pressure plant for other purposes. Design calculations indicate a heat rate of from 14,000 to 14,600 B.t.u. per net kilowatt-hour between half and full load on the plant. This heat rate corresponds to a coal consumption of from 1.03 to 1.07 lb. per kilowatt-hour.

Exhaust steam from the high-pressure turbine is also used to supply commercial steam customers. The commercial steam load on the turbine varies from light summer loads of 50,000 lb. of steam per hour to winter peaks of from 210,000 to 235,000 lb. per hour.

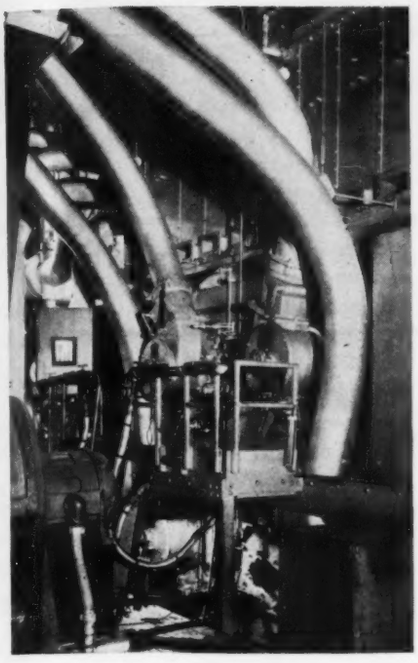
As the high-pressure boiler is considerably more efficient than the boilers in the old house, it is called on to deliver an output equal to the sum of commercial steam and electric generating requirements until such requirements are in excess of the boiler capacity.

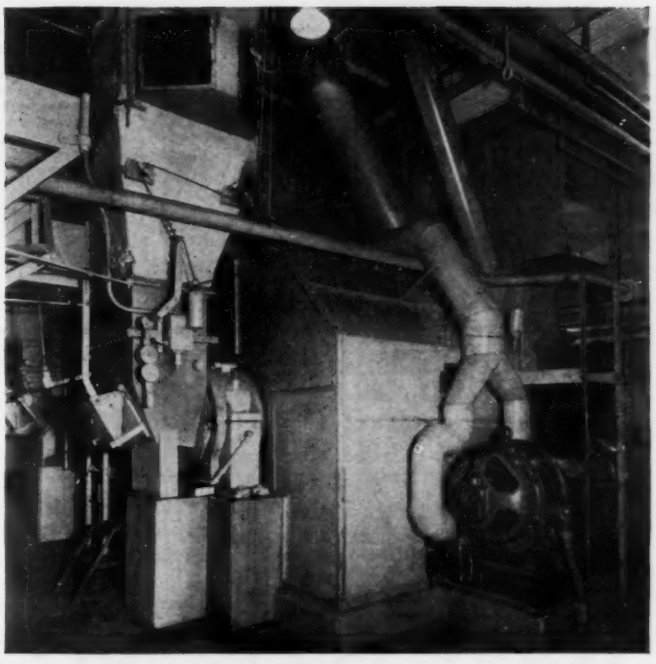
The flow of water and steam in the plant is described in the illustration and a detail of the sources of heat for feedwater is shown. Provision is made for recovery of heat in the boiler blowdown. This recovery is particularly essential with the large quantity of blowdown required in a plant having a 90 per cent feedwater make-up. The steam air preheater supplying hot air to the mills is another source of heat to the feedwater.

Boiler, Furnace and Economizer—The boiler is a four-drum, bent-tube unit furnished by the Combustion Engineering Company. The cross-section of the plant shows the general tube arrangement, shape of the furnace and position of the water walls. A fifth drum, 48 in. in diameter by 23 ft. 7 in. long, is mounted above the boiler proper and used as a dry drum.

Steam liberated in the rear drum of the boiler is thoroughly washed with incoming feedwater, passed through a single set of screens and then up to the dry drum, where the last remaining moisture settles out. Screens in the upper drum are an added precaution in drying the steam. Whatever moisture collects in the upper drum runs back to the rear drum by gravity. Steam leaving the dry drum has no entrained moisture during normal operation of the boiler.

Although the boiler is likely to be operated for long periods at a high load, it was considered advisable to install a



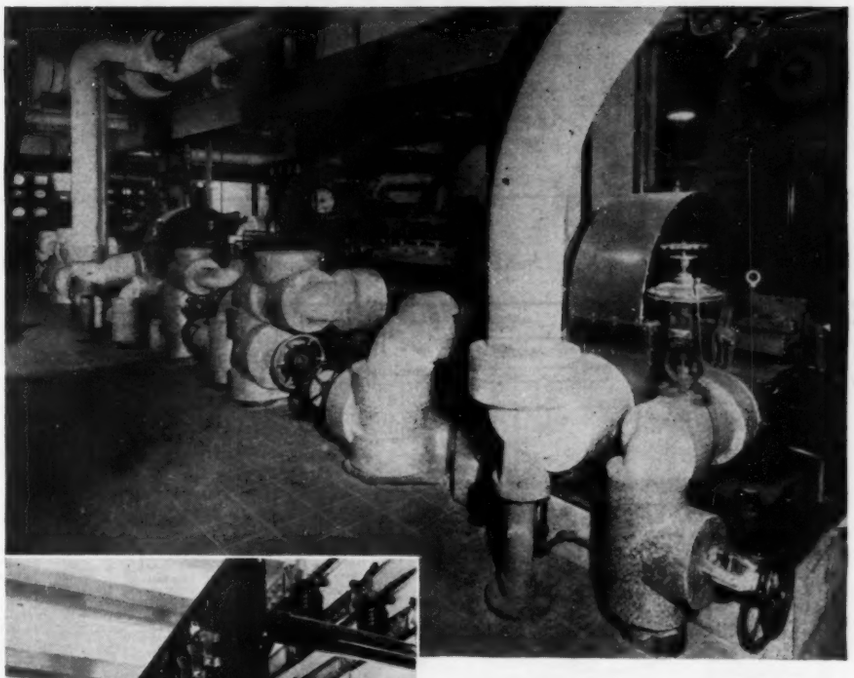


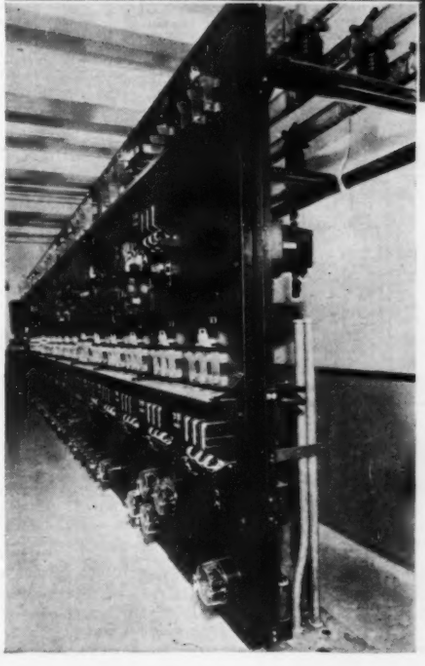
Left—Burners and exhauster piping

Right—Ball mill and steam air heater

Center—Two tandem feed pumps

Bottom—Electrical panel for plant auxiliaries





dry bottom furnace. One factor favoring the dry bottom furnace was the varied characteristics of coals. Coals with both high and low fusion ash are available. Most of the coals are from Allegheny County, thick Freeport seam. Ash falls through a large double water screen to the bottom of the furnace, where it is sluiced out by Hydrojet ash-removal equipment.

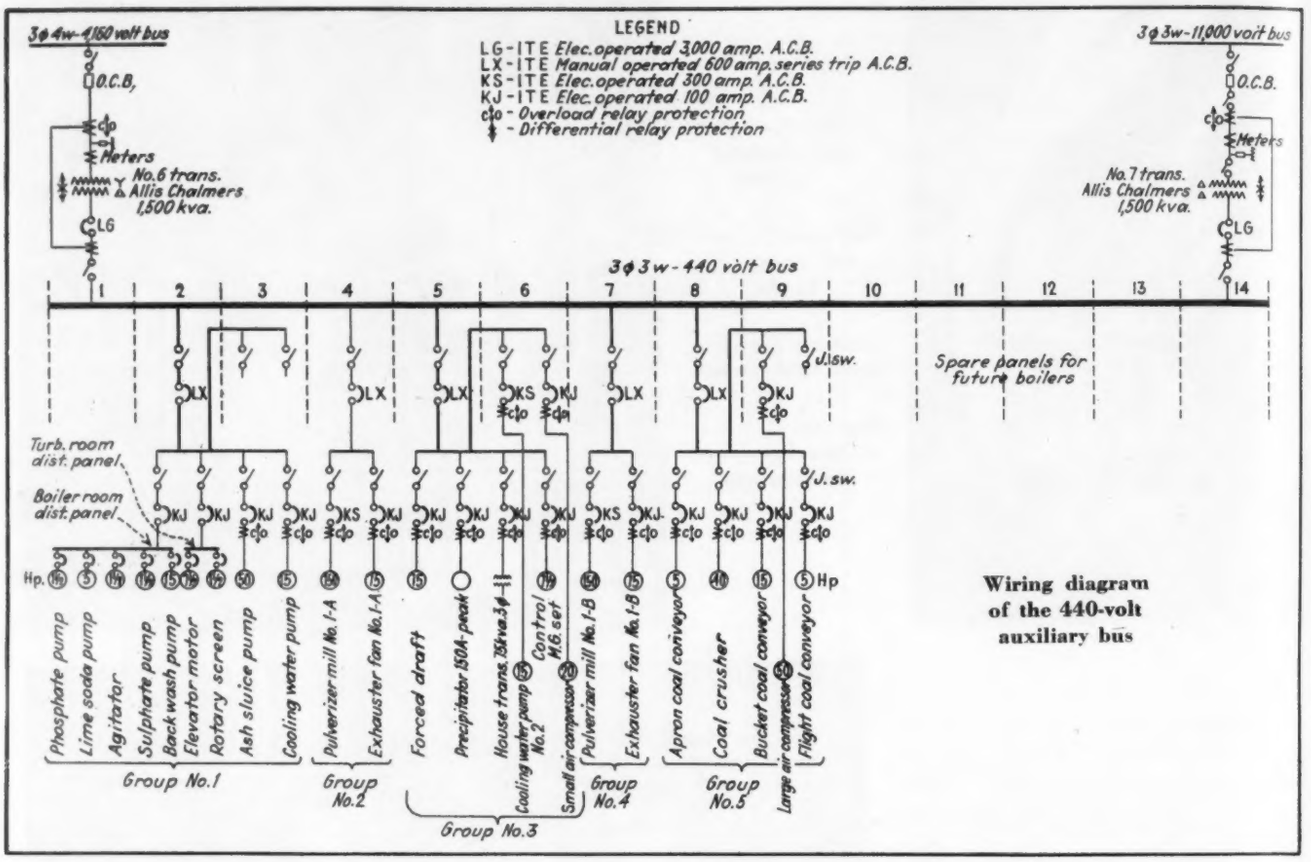
The rear wall and both side walls are of fin-tube construction, backed with 2 in. of "Moldit." Front wall and roof of the furnace are protected by water tubes spaced on 12-in. centers. Upper walls are of DeWolf arch construction and are not cooled by water tubes. Circulating tubes for the side walls are outside of the upper side wall. Lower front wall is of solid brick 18 in. thick up to a point immediately above the burner box. The remainder of the front wall is DeWolf arch construction. Furnace roof is of 2½-in. fire brick, covered with 3 in. of rockwool. The entire furnace and boiler setting is incased with 12-gage steel plate to prevent air infiltration.

A 4,032-sq.ft. Elesco superheater has both radiant and convection elements to aid in maintaining fairly constant superheat over a wide range of rating. Temperatures are somewhat higher than design, averaging about 770 deg. F. at full load.

The Foster-Wheeler extended surface economizer of 20,808 sq.ft. is designed for counterflow. Water is received at 220 deg. F. and discharged at 345 deg. Approximately 80 per cent of the heat from gases passing through the economizer is transferred to the feedwater. The gases leave between 330 and 350 deg. F., depending on combustion conditions.

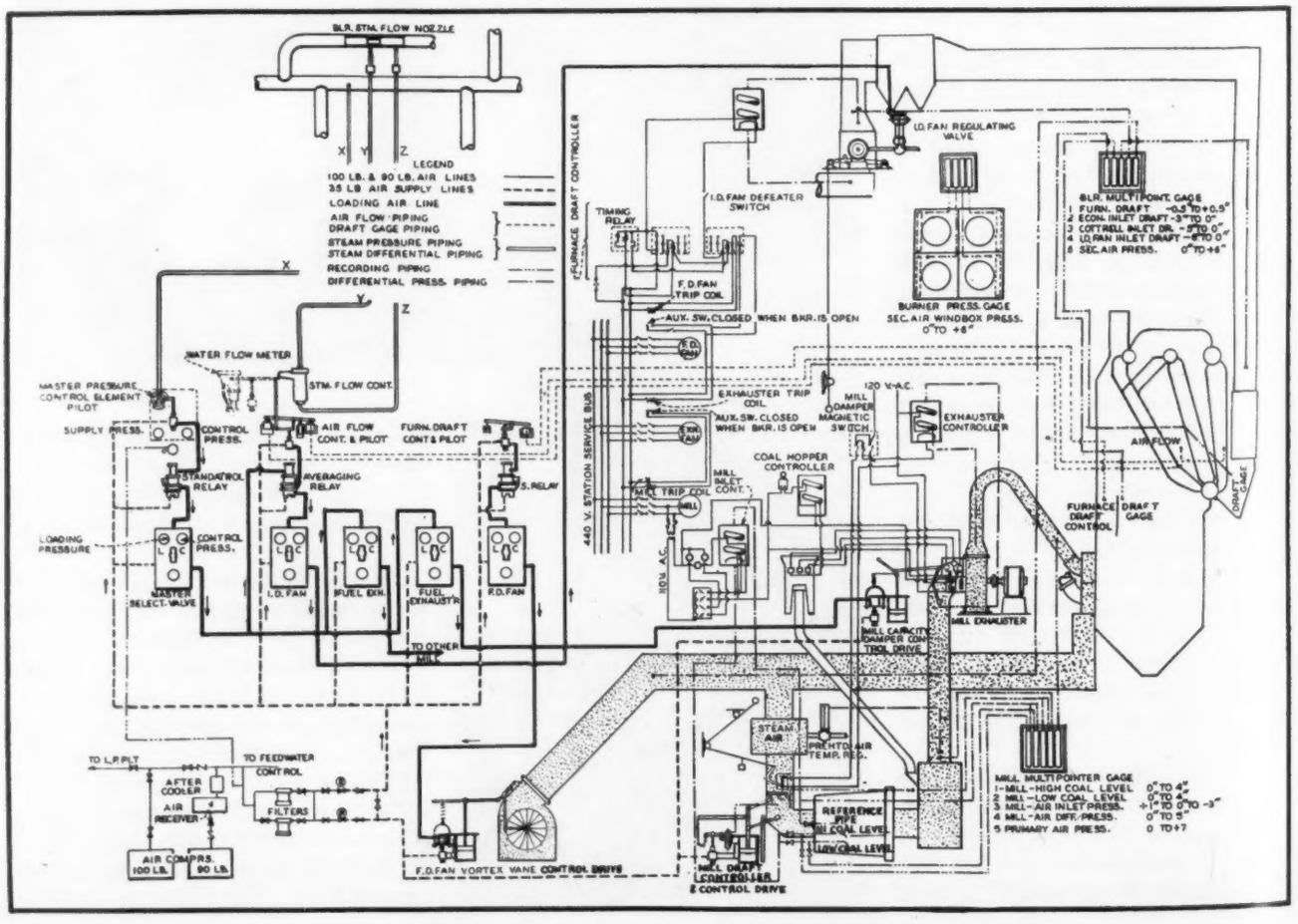
Heating surfaces of boiler, economizer and superheater and the furnace volume are given in Table III.

Turbine and Generator—The 6,000-kw. G.E. turbine is a seven-stage, 3,600-r.p.m. impulse unit governed by a speed and a back-pressure element. Piping strains on the turbine were minimized by anchoring the high-pressure steam main near the turbine and connecting to the turbine throttle through a large creased bend. The discharge piping is



Wiring diagram of the 440-volt auxiliary bus

Schematic diagram of automatic combustion control apparatus



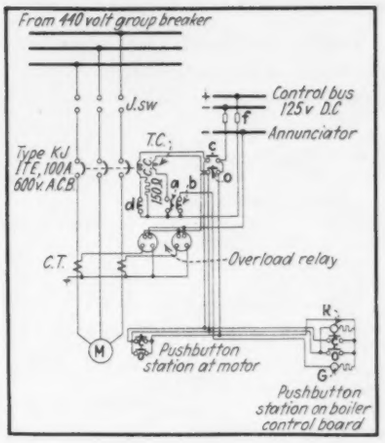
connected to the desuperheater with the desuperheater free to move in line with the expansion of the exhaust line. Performance is indicated in data and figure.

Oil to the bearings is cooled and stored under the floor at the throttle end of the turbine. Provision is made to pump oil to and from an oil room where a reserve supply of oil is maintained. A centrifuge in the oil room is used as occasion demands for cleaning the turbine oil.

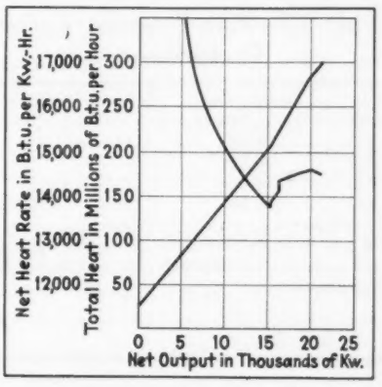
The generator is a three-phase, 60-cycle, 11,500-volt machine designed for 80 per cent power factor and has a 40-kw., 125-volt, direct-connected exciter. Generator air is cooled in a 3,350-sq.ft., six-pass air cooler requiring 160 g.p.m. of 80 deg. water.

Desuperheater — The problem of maintaining constant steam conditions entering the low-pressure plant mains is cared for by a Blaw-Knox desuperheater. The larger amount of steam passes across the top of the desuperheater and mixes with saturated steam rising from the desuperheater. The quantity of steam entering the desuperheating chamber is dependent on the amount of desuperheating required. A large excess of water is added to steam in the desuperheating chamber. Moisture is entrained as the steam sweeps the surface of water held in the lower part of the desuperheating chamber. As the washed steam rises it is dried by baffling, and finally mixes with superheated steam passing across the top of the desuperheater. Discharge temperatures are maintained close to desired values by Bailey automatic temperature regulation.

A Bailey thermal-hydraulic type of level regulator maintains a constant water level in the bottom of the desuperheating chamber.



Typical motor control circuit

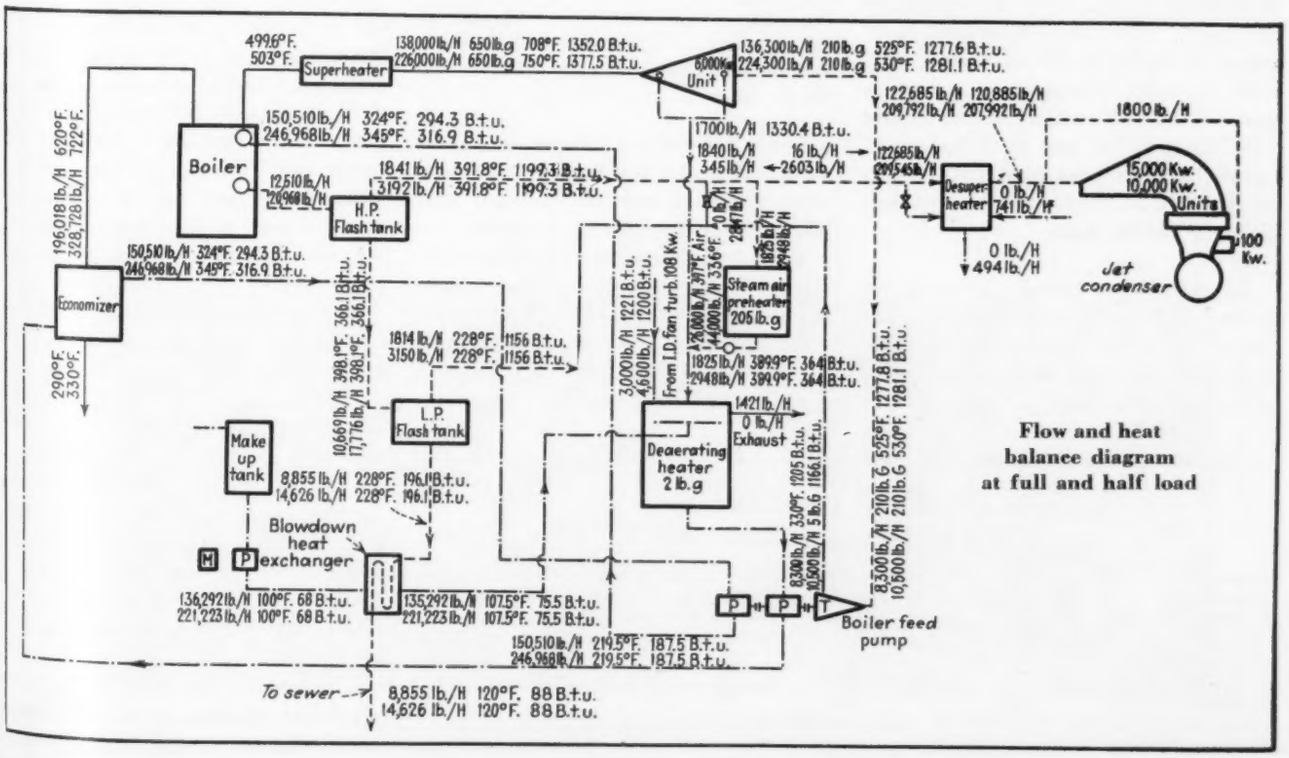


Plant heat characteristics when discharging high-pressure turbine exhaust to low-pressure turbines

Coal Preparation and Firing Equipment—Coal is brought to the plant from a nearby railroad siding by truck. At the plant it is crushed to 1¼-in. size slack and elevated to the overhead raw coal bunker. The lower part of the bunker is divided into two hopper bottoms terminating in 18-in. square Link-Belt duplex bunker gates. Coal leaving the gates is fed to the mills by the Jeffrey vibrating feeders.

Two No. 4 Foster-Wheeler Tricone Ball mills pulverize the coal. Each mill is capable of pulverizing 15,200 lb. of coal per hour. The average coal has a grindability of 0.65, Hardgrove scale, and in operation 80 per cent of the coal passes a 200-mesh screen.

A steam air preheater is used for heating mill air. This design makes a simple layout with very little duct work required. Cast-iron exhauster fans of the paddle-wheel type draw coal and primary air from the mill. Each exhauster discharges to a divider box above the fan, where the air-coal mix-



Flow and heat balance diagram at full and half load

ture is divided to two burners. The flow of air through the mill controls the rate of coal feed. Changes in the flow of mill air are made by varying the quantity of air admitted from the room to the suction of the exhauster fan. This method of mill air variation gives approximately constant burner discharge velocities and prevents flareback.

The level of coal in the mill is maintained approximately constant by a feeder control. Control is actuated by tubes measuring draft in the mill. When one of the tube ends becomes submerged in coal the differential between the submerged tube and a tube above the coal level stops the feeders. As the coal level in the mill falls the differential is lost and feeding is resumed.

Four CE Type R forced draft burners feed coal to the furnace. Burners are lit by gas torches inserted through an ignition tube at the center of each burner. Burner flame adjustments are made by varying primary and secondary air pressures and also by changing the setting of a ring of secondary air admission vanes. The secondary air vanes control the rotation of secondary air admitted to the burners and has the effect of lengthening or shortening the flame.

A 75-hp. Clarage double-suction, double-width, forced-draft fan is used to supply secondary air. This fan is motor-driven and capable of delivering 69,000 cu.ft. per minute against a head of 4½ in. of water. Air volume is controlled by Vortex vanes throttling the fan inlet. The Clarage induced-draft fan is driven by an Allis-Chalmers turbine through herringbone reduction gears. At full load this fan will handle 103,500 cu.ft. of gas at 335 deg. F. against a 4¼-in. head of water. Steam for the 200-hp. turbine drive is taken from the 210-lb. main.

Electrical Equipment—In the main generator differential protection is obtained by current transformers located in the neutral of the machine and at the oil switch. The field is provided with a Leeds & Northrup temperature indicator. The unit has been in operation several months and has operated well within the temperature guarantees.

One of the interesting features of the station is the 440-volt auxiliary power supply switchboard. This switchboard takes its power from two transformers of 1,500-kva. capacity each, one of which is connected to the 11,000-volt bus and the other to the station auxiliary 4,150-volt bus. This provides for auxiliary power in case of a general system disturbance when the 4,150-volt station bus automatically trips free from the system with one turbine supplying this bus. The 440-volt switchboard is composed of two 1,500-amp. air circuit breakers on the low side of the two transformer banks and five air circuit breakers supplying groups of auxiliary motors. These air circuit breakers are provided with instantaneous overload protection and trip in case of short circuit on any feeder.

The individual motors in each group are controlled by latched-in contactors with push-button control located at various convenient points. There is no short-circuit protection on each motor circuit, but 40-second type CO relays are used to protect the motors against overheating due to overload. This form of thermal protection is much easier to test and maintain than the conventional type of thermal overload relay. On the large motors two current transformers and two relays are used, while on the smaller motors one current transformer and relay was considered sufficient. On the smaller size current transformers the manufacturer was asked to furnish a transformer which would withstand mechanically all the current which it would pass on short circuit with sustained voltage on the 440-volt bus. This required a somewhat heavier design than the standard transformer. One desirable feature of this arrangement is that the leads from the switchboard to the motor are energized only when the motor is running, thus materially decreasing the exposure of the auxiliary bus for idle equipment. Control wiring, as well as motor leads, are run in conduit and "Rockbestos" wire was used wherever the wire might be exposed to high temperatures in any part of the run.

The control system is supplied from the 440-volt bus through a 5-kw. diverter-pole, motor-generator set with automatic throwover on undervoltage to the main exciter battery. The motor-generator set is large enough to supply all the normal requirements, so that the throwover equipment will function only in case of trouble on the motor-generator set. Similar equipment in old station No. 3 has proved very satisfactory in the past ten years of operation.

The attempt was made to design the electrical equipment to be as simple and foolproof as possible. The equip-

Table I—Plant Performance Characteristics

	Full Load	Half Load
High-pressure gross generation, kw.	6,000	3,000
Low-pressure gross generation, kw.	16,500	9,750
Equivalent kw. allowance for auxiliaries	455	313
Total gross generation.	22,955	13,063
Total B.t.u. per hour absorbed by boiler and economizer.	275,343,627	164,469,012
Total B.t.u. per hour in coal burned.	313,599,827	182,776,648
B.t.u. per kw.-hr. gross generation.	13,631	13,063
Coal rate on gross generation at 13,600 B.t.u. per lb. coal.	1.002	1.029

Table II—High-Pressure Turbine Performance

Kw. Load	Steam Flow, Lb. per Hour	Water Rate, Lb.	Exhaust Temp., Deg. F.
1,575	93,615	59.40	580
3,090	136,530	44.20	550
4,645	181,213	39.10	535
6,150	230,280	37.50	530

Conditions are given for 650 lb. per sq.in. gage and 750 deg. F. at the throttle to 210 lb. per sq.in. gage back pressure. Gland steam requirements are 1,700 lb. per hour.

Table III—Heating Surface Areas and Furnace Volume of Hp. Boiler

Boiler	15,300 sq.ft.
Water walls	3,990 sq.ft.
Superheater	4,032 sq.ft.
Economizer	20,808 sq.ft.
Furnace volume	13,720 cu.ft.

Table IV—Operating Characteristics of the Hp. Steam-Generating Unit

Evaporation Lb. Steam per Hour	Draft Loss of Unit In.	Gas Temperature, Deg. F. Boiler Outlet	Gas Temperature, Deg. F. Economizer Outlet	Efficiency, Per Cent Boiler	Efficiency, Per Cent Unit
117,500	1.30	584	270	81.2	89.4
235,000	4.75	720	330	77.1	87.6
250,000	5.40	740	335	76.7	87.3

ment is rugged and installed to prevent the occurrence of serious trouble or the spread of such trouble to more than the affected unit.

Furnace operation is protected electrically. If positive pressure is maintained in the furnace for twenty seconds the mill, feeders, exhausters and forced-draft fan trip out in proper sequence.

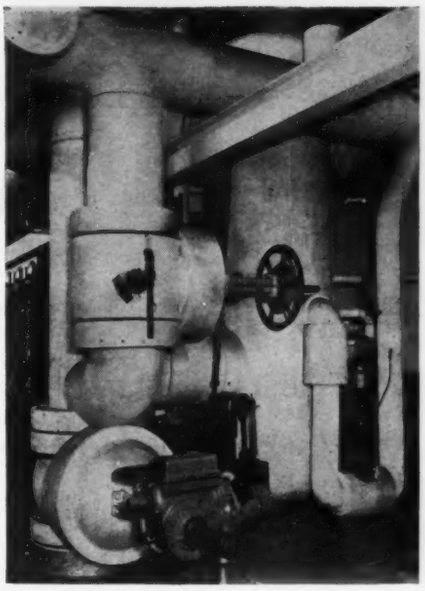
An annunciator system normally operating from a 125-volt motor-generator set indicates the trouble on any of the major plant apparatus. In case of failure of supply the feed is automatically transferred to the station battery.

Automatic Control—The Bailey system of automatic control is used for controlling the essential functions of plant operation, including combustion conditions, feedwater flow, throttling steam to the low-pressure steam mains and desuperheating the turbine discharge. A diagram of the combustion control system is shown.

All automatic control equipment may be hand-controlled or locked out of operation to allow manual operation of equipment. The system is air-operated. Air is supplied from two compressors and in an emergency air supply may be taken from the old plant.

Combustion control maintains approximately 20 per cent excess air consistently through a wide range of boiler rating. Air flow is measured by draft loss through the boiler and controls the speed of the induced-draft fan.

The forced-draft fan is controlled to maintain furnace draft. Steam pressure controls coal flow from the mill by bleeding air in at the suction of the exhauster fan. The steam flow-air flow relation modifies the primary combustion controls to maintain constant excess air.



Desuperheater and piping arrangement

Full sequence protection is given to combustion equipment in an emergency. The protection is electrically operated and prevents the development of hazardous operating conditions in the plant.

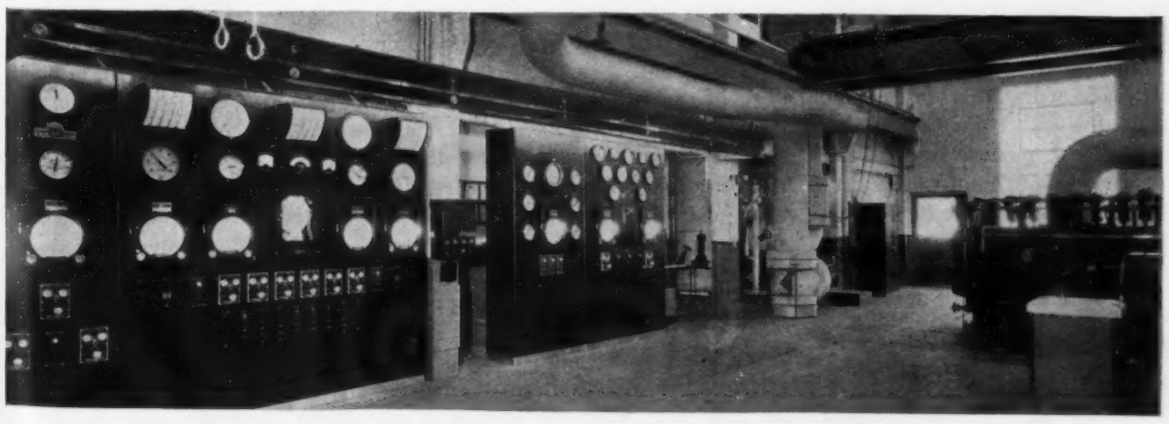
Feedwater Treatment—The Genesee River is the source of raw water for the plant. The water changes seasonally, varying considerably with the proportions of ground and surface water present. At present there is approximately 200 ppm. of solids in the water. Water at 100 deg. F. is pumped from the condenser discharge of No. 7 turbine to a Scaife water-treating plant. There it is treated with lime and sodium carbonate. Ferrous sulplate is added to aid precipitation. After preliminary treatment the unfiltered water is pumped to a Cochrane deaerating heater. Heat added raises the temperature to 220 deg. F., aiding precipitation and oxygen removal.

Disodium phosphate is added to the softener to maintain free soluble phosphates of not over 5 ppm. Sodium sulphate additions are made to the feed pump suction, correcting the carbonate-sulphate ratio to safe operating values. Water from the deaerating heater is of zero hardness and extremely low oxygen content. Magnetite pressure filters remove any of the remaining precipitate coming over from the deaerating heater. The water is then pumped to the economizer and finally to the boiler by tandem feed pumps.

Considerable work has been carried on in the analysis of steam by electrical conductivity. The indications are that boiler concentrations may be safely carried between 3,000 and 3,500 ppm. without affecting the purity of steam leaving the dry drum. These concentrations are maintained when the blowdown is equal to that shown in the heat cycle diagram.

Another extension planned

Several months of operation have resulted in minor equipment changes. The plant has performed satisfactorily and work on a duplicate installation is progressing rapidly.



Station meters and control panel for Rochester plant

Graphic Instruments Aid Power Sales

They Sell Power and Keep It Sold—Reduce the Costs of Analysis—Eliminate Customer Complaints—Improve Customer Operations

By FRANK E. WIATT
Assistant Supervisor Power Sales Division,
Union Gas & Electric Company, Cincinnati, Ohio

POWER sales departments have two functions, to sell power, and to keep it sold. It is of the utmost importance to base all conclusions on as complete and accurate data as can be made available. It should be remembered, too, that the confidence of the customer in the power salesman's recommendations will depend upon his conception of the accuracy and completeness of the information on which they are based.

The Union Gas & Electric Company makes wide use of graphic instruments in its power sales work and the results have been highly satisfactory. Then, too, there is the element of cost to be considered. The fact that a graphic meter can be connected in a circuit and left to make its record over a day or a week without requiring the continuous presence of an observer is a distinct advantage from the standpoint of cost of getting the information. A few of the many case studies we have made with portable graphic instruments follow. I have not elaborated on any one particular problem, but have given enough information to show how extensive the use of graphic instruments can be, and how indispensable they are in our efforts to do justice to our customers and to ourselves:

Saving our customer $1,000 a year

A large cold storage warehouse, purchasing alternating current, operated two 200-kw. motor-generated sets (one as a reserve) to supply direct current for its elevators. One unit ran 24 hours a day and the losses amounted to an appreciable sum during the month, as it was operated at light load much of the time.

When the customer's complaint was received we connected a graphic wattmeter in the power supply circuit, operated the elevators at maximum conditions and found the peak load was only 90 kw. A trade was made with an equipment dealer, who installed a 100-kw. set in exchange for one of the 200-kw. units. This customer, who uses more than one and one-quarter million kilowatt-hours a year, is pleased with a power saving of almost one thousand dollars a year.

How we helped out a hospital

One of our modern hospitals had a poor load factor, which resulted in a high net rate for energy. The hospital board discussed the matter at a meeting and drastic action was almost taken before we had any knowledge of the dissatisfaction. As soon as we had word of the difficulty we surveyed the loads throughout the plant with graphic meters, checking each department and piece of equipment carefully.

By changes in the operation of the ammonia compressors and electric ranges and by advancing the starting time of the laundry the maximum demand was reduced 30 per cent. Before the changes were made the demand ranged from 109 to 122 kw. During the first year after the survey it ran from 83 to 91 kw., and during the second year it varied from 78 to 93 kw. The hospital is now producing ice and bakery goods for less than the cost of purchased products, and we have not had a like complaint from it since we rendered this service.

Loss of a consumer forestalled

A barrel manufacturing plant in the throes of the depression made plans to install a steam engine in order to reduce power costs. We took a graphic wattmeter to this plant, recorded the power required to drive each group of machines idle and loaded. From these tests we were able to make recommendations for regrouping machines, reducing motor sizes and simplifying drives. These improvements cut the power bill in half. The steam engine remained on the skids in the warehouse, and another satisfied customer is still on our lines.

The graphic meter tells an interesting story

A lithographing concern believed its use of electricity for lighting purposes was far too great, and naturally claimed that the billing meter was in error. Tests proved it to be within the accepted range of accuracy, so we connected in a graphic wattmeter and its charts told an interesting story. After the plant closed for the day the cleaning people started their work and had all lights on until after midnight.

The peak demand was created after plant operating hours. The management certainly took quick action to correct this method of operation and a

noticeable reduction in lighting costs is now being enjoyed. Here is a good example of the advisability of using graphic instruments which can be left in circuit long enough to get all the information. Had our test been conducted with indicating meters for a short period only we would not have found the cause of the complaint.

A large investment avoided

We have a large paper mill on our lines which began efforts to increase production. Machines were speeded up and the demand for power reached a high peak. It looked as though it would be necessary to install larger transformers. Space for the transformers was meager, and it was a question whether to provide additional room or make other expensive arrangements. Finally, before spending the money, we decided to make a careful study of the customer's load characteristics with graphic instruments, taking records over a sufficient length of time to obtain accurate data.

When this had been done we concluded from the load characteristics (the power factor was above 0.90) that we could carry the load with the present transformers, by the simple expedient of supplying improved ventilation. This was done, and the equipment is carrying the load satisfactorily and efficiently.

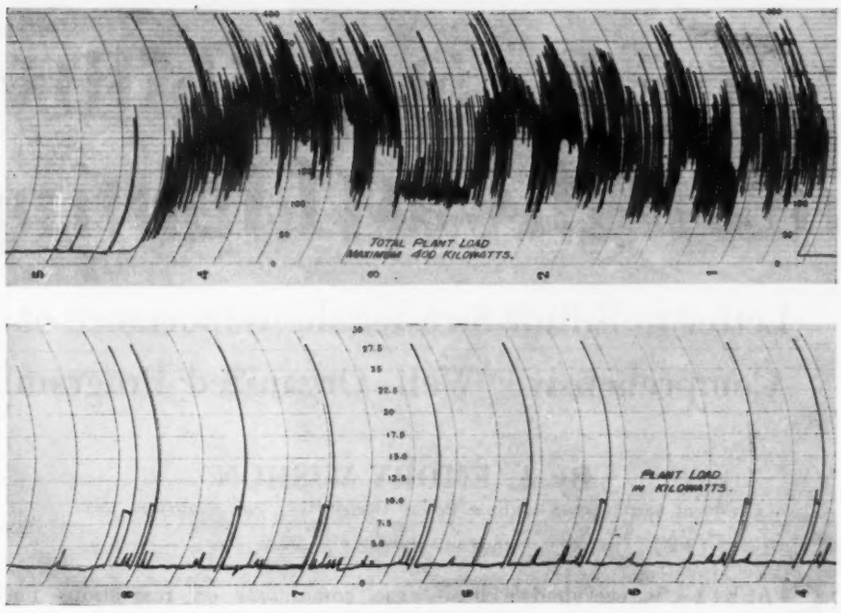
Better bearings in a brewery

A brewery kept blowing fuses on the motor driving its mash tub. A graphic wattmeter chart showed a serious overload on the motor; the cause was found in the bearings of the agitator. Ball bearings were installed and the load was reduced to about one-half the motor rating. This saved power and the motor was now really too large.

At the same time and with the same instrument we discovered that the motor on an air compressor was too small for its load. So we exchanged the motors on the mash tub and the compressor and everything was lovely. The customer had no expense except that of switching the motors and we have his good will for showing him the correct solution to his problem.

Determining required Diesel engine capacity

A food specialty concern was seriously considering Diesel-engine-driven generators to replace central station service. The Diesel capacity required was estimated from readings of a meter giving the integrated fifteen-minute demand, which, of course, did not take into account the characteristics of the load.



Two Diesel installations forestalled

The top chart refers to the food specialty customer. The peak loads, going as high as 400 kw., showed that a larger engine than the one under consideration would be required. The lower chart tells the same story of a too-small Diesel offered for the job.

We obtained graphic wattmeter charts of the load, which indicated many high peaks of short duration; the graphic power-factor meter gave a chart showing a rather low power factor. Using these data to compute the required capacity of the Diesel set, it was apparent that it would need to have a capacity 50 per cent greater than that figured from the demand meter readings. This increased the investment to the point where it was prohibitive, and in addition we saved the customer from making an installation which would have surely proved to be too small. One of the charts showing the fluctuating characters of the load is shown herewith. This shows clearly that in determining the capacity of equipment the character of the load must be taken into account.

Solving a lubrication problem

A large mattress manufacturing company had gone carefully into the lubrication problem, and while it believed that a change in the lubricating oil used on its machines was desirable, still the company was anxious to know how the power consumption of the machines would be affected.

A graphic wattmeter was connected in the motor circuit of one of the machines for a week, using the old oil. The oil was then changed and a week's record was obtained using the new oil. A comparison of the charts showed about 10 per cent less power required when the new oil was in use, and this economy was then put in effect throughout the plant, since the power saving will go a long way toward paying the oil bill.

Peak load ends another Diesel proposal

Another customer of ours was seriously considering a Diesel engine installation, but again the discovery of an occasional peak load that could not be avoided made the use of a Diesel uneconomical. The outfit would have had to be large enough to carry the peak load and would, therefore, have been operating under light loads for most of the time. The second chart gives the character of this customer's load.

These case studies will serve to show why we have found graphic instruments exceedingly useful and valuable in our power sales work.

Our Responsibility in Highway Lighting

Letter to Editor Stresses the Importance of Comprehensive, Well-Organized Program

By A. EMORY WISHON
President San Joaquin Light & Power Corporation, San Francisco, Calif.

"SAFETY" is everybody's business and, as usual, what is everybody's business is nobody's business in particular. Existing mass appreciation of the problem can be capitalized and used to advantage. But if highway lighting is to be accomplished to the degree it should be, a definite, carefully analyzed and well-planned program must be developed, and that program controlled and followed through, supported by all the interests concerned.

The development of proper lighting units and lighting layout is undoubtedly an electrical job, and one for the electrical manufacturers, lighting experts and the electrical utilities. They would necessarily work jointly with the automotive engineer and the highway engineer on such a problem. That job would carry its inspiration in the protecting and saving of human lives, but it would also reward those participating with cash income.

Reduction in accidents also saves insurance companies money. The direct beneficiaries, measured in money alone, extend throughout many lines of business and certainly very definitely into every political subdivision of government. There are, therefore, two phases of the subject—the human phase and the economic phase.

In my opinion, if such a program is to succeed it must be considered, first, from the economic angle. Cold facts, figures and policies carry no hysteria. They offer no great opportunity for heart-rending, tear-dripping oratory, but they do offer a background for calm thinking, careful planning and a resulting intelligent program, worked out step by step to the point where the spellbinders may turn on the tears, and the committees on resolutions may resolute to their hearts' content.

On that policy and planning committee should be the best minds of those industries which would benefit most, together with men of highway and traffic experience. It should organize without publicity and work without publicity until the program is completely developed. Then, of course, well-directed and proper publicity would be a part of such a program. Too much general publicity in advance of any program usually results in hasty, immature action.

As an example, in the state of California, as in many other states, our major highways are built from the gas tax receipts. Allocation of those receipts is made between secondary and primary highways, construction, maintenance, and so on. In the last session of the Legislature an attempt was made to earmark a certain percentage of highway funds for lighting purposes and it was met by very definite opposition from the Highway Department of the state, and from many associations, which feared the diversion of gas tax funds for any purpose. Certainly greater progress could have been made if that same amount of money and energy had been spent in developing an orderly plan of procedure.

Most established state and civic bodies today have their committees on public safety. In many instances they are properly jealous of their prerogatives. But if some well-informed group of outstanding men—who would shun publicity and glory—had a definite plan into which these various groups could harmonize their energies and enthusiasm, and were quietly supporting and expounding that plan, these now scattered energies and programs could be absorbed. They would be directed in tune with that major committee's plan and the whole program would stand the test of analysis.

One of the greatest dangers to highway lighting today are the safety organizations created by some secretary who, recognizing the present widespread safety enthusiasm, takes advantage of it, with a large membership income and a salary as his principal goal. Then, having to show results, he enlists tender-hearted, public-spirited leading citizens as part of an enthusiastic support of a half-baked program. Even these followers will finally recognize and welcome a well-planned, quietly placed program that has its trail cut and leads to a definite goal.

A number of lighting demonstrations have been made in California—most are now obsolete, and most of the installations haphazard. The most recent and, I think, the most efficient demonstration, is now under way on the Bayshore Highway, south of San Francisco, and is being participated in by Pacific Gas & Electric Company and General Electric Company. Also, the San Francisco-Oakland Bay Bridge will be a modern lighting job under heavy traffic.

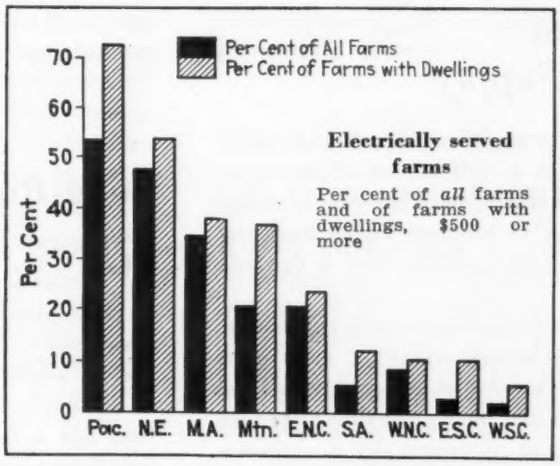
From the utility standpoint, the political and public relations angle becomes a major factor. The value of the service must be sold. Personally, I believe it can be, but that phase of the subject must never be lost control of. We have our competitors for highway moneys and we have our overburdened taxpayers to consider. The public must be shown that it is not an added cost, but a saving to the taxpayer as well as to human life.

Serve 21 per Cent of Farms With Dwellings

Saturation Figures Commonly Quoted Are Misleading —Farmhouses That Don't Exist Can't Be Electrified

FARM electrification in the United States has progressed farther than might be inferred from the statistics usually quoted. This fact is forcefully demonstrated by a tabulation recently published by the Edison Electric Institute, which gives for each state not only the number of farm customers and the percentage of all farms receiving service but also the percentage with respect to farms with dwellings of $500 or more. Obviously an untenanted farm or one with a mere shack is not a good prospect for electric service.

From this it appears that while electrically served farms constitute only 12.5 per cent of the total, they comprise nearly 21 per cent of the number of farms with dwellings. Only a few regional figures can be quoted here, for the Pacific Coast states the ratio rises from 53.8 per cent of all farms to 72.6 per cent saturation of those with dwellings, and in New England from 47.9 to 53.9 per cent. Some states far surpass these ratios. Utah rises to 94.3 per cent, Arizona 88.0, California 80.2, Washington 77.5, New Hampshire 76.6 per cent.



Conditions affecting the use of electricity differ greatly between those regions in which agriculture depends largely on irrigation and those in which it does not. Approximately, the 100th meridian is the dividing line. East of this line the average consumption per farm is comparable with the consumption per domestic customer, and at similar rates per kilowatt-hour. Most states show less than 1,000 kw.-hr., although this is nearly doubled in Florida with 1,985 kw.-hr. West of the line, however, we find such figures as 11,799 kw.-hr. for California, 11,295 for Arizona and 3,116 kw.-hr. for Louisiana. This large-scale consumption naturally permits the sale of energy at power rates.

Even in the depression years the number of electrically served farms increased in the country as a whole, year by year, as these totals show: 1932, 709,449; 1933, 713,558; 1934, 743,954; 1935, 788,795. Compared with 177,561 at the end of 1923 there has been more than a fourfold increase.

Incidentally, it may be noted that this progress was made under private initiative, and that during the same period the rate of increase in the number of farms served has greatly exceeded the rate of domestic customers.

This movement is now speeded by action of the R.E.A.

Irrigation Affects Farm Use

Data by Edison Electric Institute

	Year 1935	Year 1934	Year 1933
States Approximately East of 100° Meridian			
Farms served	572,516*	534,203*	507,522*
Kw.-hr. sold	481,688,000	425,432,000	388,549,000
Revenue, $	26,832,200	26,025,000	25,041,800
Kw.-hr./farm	872	814	770
Avg. annual bill, $	48.57	49.82	49.65
Revenue/Kw.-hr., ¢	5.57	6.12	6.45
States Approximately West of 100° Meridian			
Farms served	216,279*	209,751*	206,036*
Kw.-hr. sold	1,210,710,000	1,432,022,000	1,243,994,000
Revenue, $	21,572,400	23,157,600	21,460,100
Kw.-hr./farm	5,673	6,833	6,038
Avg. annual bill, $	100.98	110.49	104.16
Revenue/Kw.-hr., ¢	1.78	1.62	1.73

Number of Farms and Farm Customers

Edison Electric Institute

Region	Farms April, 1930	Served End 1935	Per Cent of All Farms	P.C. of Farms With Dwellings*
United States	6,288,648	788,795	12.5	20.9
New England	124,925	59,804	47.9	53.9
Mid. Atlantic	357,603	124,446	34.8	38.2
E. No. Central	966,502	199,077	20.6	23.9
W. No. Central	1,112,755	94,608	8.5	10.4
South Atlantic	1,058,468	60,096	5.7	12.2
E. So. Central	1,062,214	34,485	3.2	10.3
W. So. Central	1,103,134	25,036	2.3	5.8
Mountain	241,314	50,405	20.9	36.9
Pacific	261,733	140,838	53.8	72.6

*Based on farms with dwellings of $500 or more, from 1930 Census of Agriculture.

Editorials

L. W. W. MORROW · EDITOR

Looking Ahead at the Power Supply

WHAT will the future power supply look like? One vision is that it will consist of enormous hydro and steam plants interconnected by high-voltage lines that supply energy to subtransmission lines and distribution agencies in each locality. This is the bulk supply-grid idea.

Another idea is just opposite to this conception. It visualizes a host of relatively small and some quite small stations permanently located and supplying local loads, with transmission and interconnecting lines used sparingly for diversity and emergency ties at comparatively low voltages. This system entertains the idea of power plants at all industrial plants of any size that use process steam, at some hotels and office buildings in cities, at local farms when widely spaced and at load areas of relatively small magnitude in cities—say 100,000 to 200,000 kw.

Which one is correct? No one can say, but present facts on costs, on service and on technical developments favor the second. And the conclusion is sound that the facts and the economics of power supply should and will prevail rather than any preconceived plan or the existence of existing systems.

Hydro plants now are at maximum efficiency and most of the low cost hydro developments have been made. It is twice as cheap to transport coal as it is to transmit electricity any distance, and there is no economic trend or research development that promises to change this condition, despite much publicity to the contrary. Service quality and continuity, as well as the increase in load densities, favor local generation as against transmission.

But what about the steam plant and the internal combustion engine. Fuel plants are of only 30 per cent efficiency today. From a sales and manufacturing point of view there is little standardization, co-ordination or unity. From a technological and commercial point of view major economies are possible in these fuel stations that will reduce the cost of power very greatly in the future. Moves are under way now to get these advantages into commercial operation. Just because no one has made a farm unit, an industrial plant unit or a central-station unit to take advantage of the present commercial and technical situation is no reason to say that some one will not do this in the near future.

These two conceptions of a future power supply differ. Which is right and which is wrong means a great deal to the nation. Then why do not engineers who know make an unbiased appraisal of the present facts and trends so that those concerned with financial and political aspects of power supply could make programs that are based upon the soundest engineering reports to be had? Both utility executives and governmental officials need to know the facts and trends. Why wait until billions are spent or are lost? This is the greatest opportunity engineers have had in fifty years.

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Long-Range Forecasting

FLOODS, drought, heat and cold take an enormous human and financial toll in this country. Can they be anticipated by having long-range forecasts? Nobody knows. Serious study of sun spots, run-off, precipitation, weather cycles and other factors has been had to the degree that there is at least encouragement to the idea that a really well-planned research study would give some positive results.

We hope such a research will be undertaken. It should be supported by the electrical industry, for it has much at stake in long-term forecasts of weather. Some hydro properties have made studies and drawn conclusions in the past. Then they found they were wrong again. But we know more and have better data today. Long-range forecasting is warranted and is needed.

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Ross Plan for Federal Power

AN INTERESTING proposal has been made by J. D. Ross. He suggests that the federal government own and operate all of its power projects and transmission lines and advocates the adoption of the same wholesale rate schedule for these undertakings. Power from these projects would then be sold to local utility distribution undertakings, which would adjust their resale rates to local service conditions. He is opposed greatly to the state or the federal government going into the power business in local distribution. While advocating municipal ownership and seeking to give municipals first chance at federal power, he would grant private utilities the right to buy and distribute the power and would pay a fair price for these utilities wherever duplication or competition exists.

This is his basic proposal. But he goes further. He advocates 240,000-volt interconnection between Skagit, Bonneville and Grand Coulee to be built at once by the government. He believes these lines would give flexibility in the use of these water powers, firm up the joint power possibilities and aid in creating a market more rapidly. A duplicate circuit of 260 miles between Bonneville and Grand Coulee and another of 160 miles from Bonneville to Tacoma are advocated for immediate construction at a cost of $35,000 per mile. He also advocates a similar high-voltage line from Canada to Mexico along the coast.

No fear as to the use of the power is expressed by Mr. Ross. The three states had greatest energy use in 1929. This was 4,689,898,000 kw.-hr. If the depression had not come, he says the 1936 use would have been 9,380,000,000 kw.-hr., and he estimates the 1942 use as 18,760,000,000 kw.-hr. To the present total capacity of 1,482,118 kw. he would quickly add the contemplated additional capacity of 2,063,000 kw. in Skagit, Coulee and Bonneville.

This report of Mr. Ross is an interesting document. His estimates may be challenged as well as his conclusions. In our opinion he is overoptimistic on the growth in power use. He also neglects essential economic and service factors in power supply that would economically discredit his proposed superpower system. It is a document written in simple language to get voters to defeat the proposal that comes up in November that would put the state in the power business and to get his ideas on power accepted.

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Are Engineers Cowards?

SEVERAL letters and comments recently from engineers and others say that the engineering profession has lost its integrity and passes up opportunities to render public service because of fear or other inhibitions. It is stated that leaders have preached the duty of engineers to contribute to public service for years, and now that tangible opportunities offer, they and their official organizations, such as the professional societies and American Engineering Council, sidestep the issues.

To point to cases. It is said no engineering action has been taken to outline any public policy with respect to power, technology or industrial organization. No action has been taken to present the facts on technological unemployment, on industrial decentralization, on federal power projects or other current national problems whose solution involves engineering knowledge in major degree.

From a look at the record the indictment is true. But we believe that this comes about because engineers have paid very little attention to these matters. They were the greatest sufferers during the depression. Now they are quite busy with new engineering work. Of course, there is also a natural reluctance to get into these matters because they are all mired in a morass of politics. Engineers do not think that the average politician has any use for facts or competent opinions.

From a public service point of view, however, undoubtedly the engineers are avoiding an obligation and an opportunity. They must think of the public and the public interest and not of the politician. They must put their facts and opinions before the public with faith that a democratic people will grasp facts and act accordingly.

If the professional societies and the American Engineering Council wish to vitalize their activities and to contribute to public welfare now is the time to act. Their best leadership and talent should be given honestly and devotedly to national developments that are based upon engineering.

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Use Gasoline Taxes for Highway Lighting

INCREASED interest in highway lighting may be noticed in many sections. It is the answer to "sudden death" in the dark and it adds to the pleasure of night driving. The new sodium and other highway lights are perfected for the service required and no technical or psychological handicap exists to a rapid expansion of this business.

But the inevitable reply given to suggestions that highways be lighted is: Where is the money to come from? Why not use the gasoline taxes or a portion of them to perfect and make safe the splendid highway systems built and supported by this special tax? Most states have already built their good roads out of these gasoline taxes. As a consequence there should be funds available for this most valuable addition to these highway systems.

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Air Conditioning Booming

MORE THAN $20,000,000 of air-conditioning orders were booked by manufacturers in the first six months of this year. This new industry has arrived. In localities where utilities get behind the business remarkable progress is being made. For example, the Commonwealth Edison has a record of 247 air-conditioning plants in the first six months. The Stevens, Palmer House and Harding hotels put air conditioning in guest rooms. Seventy-nine jobs were in private and general offices, fourteen in residences and fifty-two in restaurants. There are now 1,181 installations totaling 54,839 hp. on this utility system.

Air conditioning needs the promotional talents of the utilities. It is still a new industry. It needs to be sold, demonstrated and pioneered in the same manner as was done in the early days of other electrical appliance sales.

Straws in the Wind

MANY YEARS ago a gentleman named Aristides was exiled from the city of Athens—by a popular referendum. While no records were kept as to the precise count of the vote, it is rather obvious from the comments of the scribblers of the day that the vote was pretty heavy.

The only detail of the story that survives is that a stranger walked up to Aristides on the day of the vote and, not having the slightest idea who he was, asked him to vote to banish himself. Aristides' inquiry as to why this stranger wanted him to take a long trip brought the response that this chap was fed up with hearing Aristides called "The Just."

All of which seems to prove that it was just as difficult to explain logically what made people vote one way or another in that ancient day as it is now. So perhaps a deduction which springs naturally to mind from a recent election may be silly beyond words, or may be sound as the dollar used to be.

But it would seem that the people of Knoxville, Tenn., and its environs should be T.V.A. conscious. Three thousand persons are employed in T.V.A. headquarters in that little city. They have been living there now for about three years. They were entitled to vote, incidentally, and most of them did.

That is only one element of it, however. The point is that naturally in these three years the T.V.A. workers must have made many friends among the other folks there—must have visited and talked with them—must have expressed their own views about the big job. Also, the local folks not working for T.V.A., both in the city and in the country around it, must have formed rather definite opinions. Else they would be different from people in any other small city in this country the writer ever heard about. Else, in fact, they wouldn't be human.

SEVERAL weeks ago a staff writer for New York's biggest tabloid paid a visit to this vicinity. From Knoxville he wrote a glowing story of how the folks "down here" saw the magnificent work being done, enjoyed the cheap electricity already resulting, and gave thanks, one might deduce, in their nightly prayers that Roosevelt and the New Deal had brought this blessing into their lives. In a dispatch a bit later from Chattanooga he writes scathingly of the "Power Trust" engaged in a "sniping legal attack" on this boon to mankind. Rather interesting, by the way, in view of the clear import of the Supreme Court's T.V.A. decision.

But one might draw the deduction that if the people around Knoxville really felt the way this enthusiastic New Deal writer described, and if they were told in no uncertain tones that President Roosevelt, George W. Norris and, in fact, the whole Democratic party just couldn't wait to get the word of a Democratic victory down there, they would vote Democratic regardless of any petty local scraps—or old political convictions.

Well, they didn't. On the sixth of August, less than two weeks before this glowing article was printed in New York, with nice pictures of the scenes on which the Knoxville folks could gaze, there was an election for county officers in Knox County, which includes the city and a bit of surrounding country.

A Republican was elected Sheriff by the biggest majority in the county's history! For the first time since 1918—the year Woodrow Wilson appealed for a Democratic Congress—every Republican on the county ticket was elected! If you must have details, J. Carroll Cate, Republican nominee for Sheriff, received 16,061 votes. The Democratic nominee, J. D. Val Crippen, received 10,873. And an independent Republican candidate had 2,658.

AT THE closing Democratic rally before election Gordon Browning, Democratic nominee for Governor of Tennessee, told what seemed to be an enthusiastic Democratic audience that President Roosevelt was more interested in Knox County than any other county in the country! He told them that he would take pleasure in wiring President Roosevelt the morning after election how he, the New Deal and T.V.A.'s contribution to the lot of the common man, had been gloriously sustained.

This was not the assurance, warning or promise of some unimportant figure. Gordon Browning was nominated for Governor of Tennessee by a majority of 135,000, roughly, against the combined opposition of both United States senators and the state organization. He is not the type of man whose words would be taken lightly by the voters of Knox County. The victory made him easily the most important Democrat in Tennessee today.

Now it would be easy to draw a lot of deductions. One might figure that the T.V.A. workers were just a lot of Republicans. Or that they thought the project on which they were employed was a waste of the taxpayers' money and should be stopped. Or that it was so sound that they had no fear it would be stopped even if Landon should be elected.

Remembering Aristides, however, there are other possibilities. It is mighty hot down in the valleys of East Tennessee in early August. Even the nights are almost unbearable unless one gets up on top of the mountains. So it is just possible that during the heated period the boys and girls get very tired indeed of hearing T.V.A., Roosevelt and the whole shebang praised in extravagant language every time they turned around.

It is a natural human reaction. It is a standing joke in most newspaper offices that the composing room crew is always opposed to any candidate that particular paper is boosting. Setting the type boosting the fellow is just a chore for them, but they get sick of hearing one particular man praised. Aristides again.

It is very difficult to down the suspicion, however, that these close observers of the waste and extravagance which always go hand in hand with any governmental conduct of an enterprise simply figured out they could not be for an Administration which could be boasting about such a thing.

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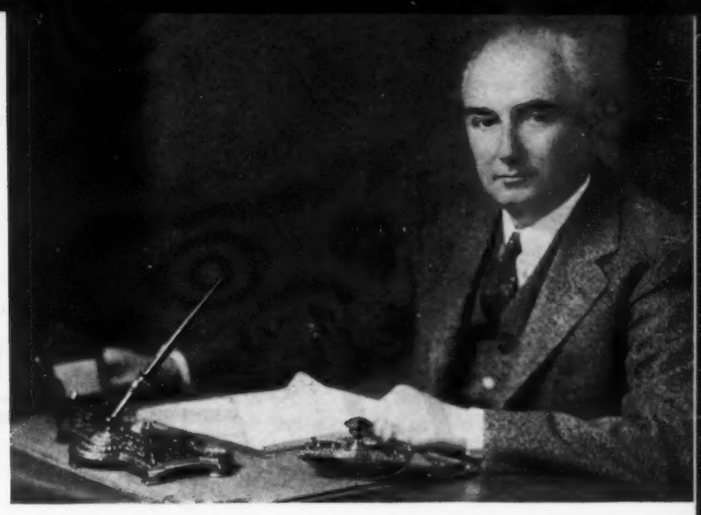
For the time being—which certainly means until after election, and may mean something more—the govern-



—By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

ment is not going to press any legal battle to impose the terms of law providing for regulation of public utility holding companies on any company that is not clearly engaged in interstate business. In the case against the Consolidated Edison Company the government's legal forces marched up the hill, and then, when the case came up in a New York court, avoided any sort of test by the simple expedient of not being there. The only government attorney in sight seemed in danger of being forced into the case by a somewhat irritated judge, but earnestly protested he knew nothing about the case—was just there as an observer.

So cutting those power lines at the New York-Connecticut boundary may have saved the expenditure of considerable legal energy.

* * *

Another black eye for holding companies, with no possible political ramifications this time, and absolutely regardless of the merits of the particular case involved, resulted in the "Chain and General Equities" case. In this legal fight it was alleged that the stockholders of this company suffered a loss of $202,000 because their company bought some securities from the sponsor.

It is not important for the point here made whether this transaction was on the square or not. It may have been poor judgment on the part of the managers of the company. Or it may have been something worse.

The point is that this sort of thing feeds the very prejudice which President Roosevelt invoked in his fight to eliminate the holding companies. The average newspaper reader takes such a case as clear proof that the big fellows are looting the little investors in such instances—that the main object of a holding company is to raid the treasuries of companies whose stocks it holds.

There is no political significance to all this, because before the campaign is over Governor Alf M. Landon will be found to be just as much in favor of regulating holding companies as President Roosevelt—though perhaps not so bloodthirsty on the death sentence.

WHAT is political, and rather flabbergasting, to the disinterested bystander—if there be such—is that the coal miners should be for an Administration which seeks so vigorously to develop competition which can only result in reducing the amount of work there is in this country for miners to do. Of course there is no assurance that the miners will vote as their leaders tell them, but after all if the work, for example, of 10 per cent of the miners should be made unnecessary by increased production of hydro-electric power, union dues would also decline 10 per cent. Union miners pay dues only when working. The dues are deducted from their pay by their employers and sent to union headquarters direct.

No one knows but that a few years hence it may be much more economical to produce electricity from coal than from water power. But the big item of cost in water power production is the interest on construction costs—and taxes on that construction if it is a privately owned plant. So that once built the plant is there—a permanent menace to the coal miner's job.

Yet they talk about the pocketbook vote being the most important!

PWA LAWYERS are more disturbed than they will admit over the suit against the Platte Valley Public Power and Irrigation District. The argument made by F. O. Feltz, who happens to own some land on the Platte River just below the dam, is that the project plans to take water out of the Platte River and divert it to the Republican River water shed.

Legal sharps here agree that nearly every precedent in riparian rights cases is along the same line. When any one takes water out of a stream it must be returned to that same stream, else the people living further down on that stream have a just claim for damages. Even where water is used for irrigation, if it is used in the same watershed, presumably it drains back again into the same stream from which it was taken. In the case of power, of course, or the use of water for cooling machinery, it virtually all goes back.

For example, it is estimated that every drop of water flowing down the Mahoning River, through the steel district which includes Youngstown, is used more than 40 times. It gets so heated that summer visitors to Youngstown sometimes draw their tubs before going to bed at night, so that the water will cool a little before morning. But it all finds its way back to the stream.

Mr. Feltz's complaint would be on all fours with the kick a Youngstown steel mill would have if some of the mills higher up on the Mahoning River should divert the water they use to some other valley. It's just PWA's bad luck that this case should come in a drought year, when all Mr. Feltz's neighbors farther down the Platte are likely to get excited about the possibility of their river-front property bordering on a dry ditch.

Altogether the New Deal seems to be a pretty good thing for lawyers.

News OF THE WEEK

Utility Law Speakers Stress the Dangers of Federalization

Leading attorneys of the nation take issue with exponents of more rigorous control of industry by governmental bureaus

Changing tides in public opinion were indicated in the utility field by speakers before the Public Utility Law Section of the American Bar Association who threw into sharp focus the trend toward federalization of public service corporation business embodied in regulative acts sponsored by the national Administration. More than five thousand registered at the Boston convention of the parent body, and throughout the proceedings concern was frequently manifested for constitutional integrity, with all its implications as to the fostering of individual initiative and for preserving the powers of the states in regulating manufacturing and commerce. The Public Utility Law Section held three sessions on Tuesday and Wednesday, at which regulation and legislation featured the program, including a powerful attack on the Holding Company Act by John W. Davis of New York.

Chairman J. J. Murray of the Massachusetts commission welcomed the delegates to Boston, pointing out the necessity for greater co-operation between utilities, regulators and the judiciary if a better-rounded regulation is to be achieved. The speaker urged a more complete analysis of rates, financing and operating practices as a progressive policy. Section Chairman George R. Grant reviewed trends in governmental price regulation in a scholarly address, intimating that if price regulation has failed in utilities (which he did not admit), it would likewise fail in application to general business. Mr. Grant showed that present trends toward regimentation imperil initiative and individualism in business and warned his hearers that the time is here for believers in business freedom to do battle for their convictions.

An entire session was devoted to the Public Utility Act of 1935, Title 1 being interpreted in a paper by Robert E. Healy of the Securities and Exchange Commission and Title 2 by Clyde L. Seavey of the Federal Power Commission. Judge Healy emphasized the efforts of his board to develop its responsibilities through co-operation with both registering and non-registering holding companies. To August 15, 375 applications for exemption had been received, of which 65 have been granted and 124 withdrawn. Sixty-five holding companies are now registered. Most of the major systems have declined to register and have brought constitutionality suits. The commission staff includes many former utility men. Thus far the commission has not been obliged to pass upon any reorganization plans in anticipation of the so-called "death sentence."

Seavey asks for historical costs

Commissioner Seavey characterized recent federal legislation bearing upon utilities as the most effective and comprehensive ever achieved in two Congressional sessions. He declared that the whole theory of the Holding Company Act demands the joint functioning of federal and state jurisdictions and advocated using the historical cost rate base with a variable rate of return.

Section Chairman George R. Grant speaking to American Bar Association members at Boston

Chairman S. S. Cushing of the Vermont commission said that most of the regulative work necessary in public utility operation can be better handled by state commissions working singly or jointly than by federal boards. Henry C. Attwill of the Massachusetts Commission reviewed the history of that board at the session on Wednesday.

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Thirty American Papers Completed

Acknowledged experts to discuss power needs of nation at World Power Conference — Panorama of power exhibits open — German delegates named

Discussing the policies and plans of the private and public agencies engaged in the development of power in the United States, 30 American papers, written by acknowledged experts, have been completed for presentation at the Third World Power Conference, to be held in Washington next month.

Holding companies, public vs. private ownership, national power policies, the reconstruction of utility distribution networks, rural electrification, the regulation of the oil industry, conservation of coal—in fact, almost every phase of power has been discussed from the public and private point of view.

The papers outline the power needs of the nation and discuss them from the standpoint of the practical business man, from the standpoint of the government officials, and, in some cases, from a more or less philosophical outlook. The papers have been prepared on the topics set forth on the conference program (ELECTRICAL WORLD, June 13, page 6).

The second unit of the World Power Conference Panorama of Power exhibits was opened this week in "Power Hall"

of the Arts and Industries Building of the Smithsonian Institution. Prepared for the 3,000 foreign and American representatives expected to attend the conference, the exhibit shows in retrospect the world's power developments from the inception of the old philosophers' toy turbine 1,900 years ago up through the era when the power company gave away light bulbs and meter men carried scales to weigh the current consumed.

One of the exhibits is the invention of Dr. Elihu Thomson, the first three-phase dynamo ever built. Also in the steam display is a model of "Old Bess," the engine constructed by James Watt in 1777. The electric power section is replete with the historic magnetic models that pointed the way to modern electric motor and generator. Another exhibit tells the fascinating story of the incandescent lamp. A model of the first electric central station that was built by Thomas A. Edison in New York in 1882 is cross-sectioned.

Delegates visit New York

First unit of the exhibit was opened last week at the New National Museum of the Smithsonian Institution. Models, maps, pictures and charts are included in the exhibit, which presents in miniature a view of the power development of the United States. Probably the most elaborate of the exhibits is the model of Bonneville Dam, an exhibit of the U. S. Army Engineers.

Delegates from foreign countries this week and next are making study tours in New York City to inspect the city's electric power plants, details of business management, sales promotion, employee problems and technical development.

A delegation of some 125 Germans, including representatives of the government, German scientists and industrialists sailed this week on the *Bremen* to attend the conference. The delegation includes Gen. Franz Ritter von Epp, Governor-General of Bavaria, and Dr. Julius Dorpmueller, president of the Reich Railroads and president of the World Power Conference.

Included in the German delegation will be Carl Krecke, chairman of the German National Committee of the World Power Conference; Dr. Conrad Matschoss, director of the Second World Power Conference; Dr. Wilhelm Wechmann, vice-president of the German Railroads. Germany is also sending a group of important utility executives, including Dr. Richard Fischer, director of large power plants in East Prussia; Dr. Xaver Mayer and Dr. August Menge, directors of large utilities. Others in the delegation include Dr. George Freitag, Dr. George Garbotz, Dr. Theodor Rehboc, Dr. Georg Keinath, director of Siemens & Halske; Dr. Ernst Tengelmann, Dipl-Ing. Franz zur Nedden and Alfred Bayer.

Holding Company Act Denounced as Threat to Citizens' Liberties

John W. Davis and George R. Grant oppose drastic control attempted by Act — S.E.C. Commissioners criticise courts, assert commission only in experimental stage

John W. Davis denounced the Public Utility Holding Company Act of 1935 as "the gravest threat to the liberties of the American citizen that has emanated from the halls of Congress in my lifetime" in a bitter, lashing address before the section on Public Utility Law of the American Bar Association in Boston this week.

Mr. Davis continued: "There is something in this act that arouses me far beyond the scope and tenor of the act itself. In one respect it is unique in the history of our legislation; in one respect it constitutes the gravest threat to the liberties of American citizens that has emanated from the halls of Congress in my lifetime. That is strong language. But I mean to make it so.

"What method of compulsion is relied upon by the government for the enforcement of this act? This act denies to the resistant or non-complying companies the right to use the United States mails, which by statute have a legal monopoly in their field. They are put, as it were, under a species of domiciliary arrest. This is an attempt not to regulate the mails but the conduct of those who use them!"

Mr. Davis had previously expressed his sympathy for the sincerity and industry which the members of the S.E.C. had shown in enforcement of the Holding Company Act, broadly intimating at the same time his conviction that the act would soon be declared unconstitutional by the Supreme Court.

"My sympathy for the S.E.C. is lessened, however, by the belief that it is going to be relieved of this additional task, relieved of it by a judicial determination of its unconstitutionality," he said. "I do not believe that Congress has the power to regulate, control or suppress a holding company as such."

George R. Grant, chairman of the Public Utility Law Section, warned that increasing governmental attempts to regulate every kind of private enterprise threatens to alter our whole business structure. He maintained that we must decide now whether "we shall attempt to resist or shall go along with it and endeavor to like it."

Commissioner Clyde L. Seavey of F.P.C. discussed the Federal Power Act of 1935. He declared that both state and federal regulatory bodies face an impracticable, in most cases an impossible, task in attempting to determine property bases under the legislative standards imposed by the Supreme Court. He main-

HOGGED FUEL FOR PORTLAND POWER

More than 8,000,000 cu.ft. of hogged fuel piled adjacent to Station L of Portland General Electric Company. Fuel comes by conveyor from Inman Poulsen sawmill in background. This fuel produces about 800 kw.-hr. per cubic foot

tained that the court had practically held that reproduction cost was the criterion for the determination of fair value, but that this method was highly uncertain and speculative.

Robert E. Healy, member of S.E.C., declared that federal regulation of public utility activities must still be regarded as in the "experimental stage." In administering the Public Utility Holding Act, he maintained, the S.E.C. did not regard its task as that of "driving an entering wedge for public ownership." He asserted that "fortunately the act provides extensive flexibility of procedure so that the commission may gradually develop substance of regulation in the light of actual experience."

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Commerce Bureau Issues Report on Utilities

Second in the series of studies of basic industrial markets being made by the marketing research division of the Bureau of Foreign and Domestic Commerce is a report on "Gas and Electrical Utilities." It shows the location of plants by counties and gives statistical data of value to manufacturers of industrial machinery and equipment. The study follows the same lines of the report on the textile industries issued some months ago.

Tennessee Area Bristling With Injunctions Against T.V.A.

Utility companies, forming front-line defense against extinction, abandon efforts at conciliation — Seek protection of federal courts

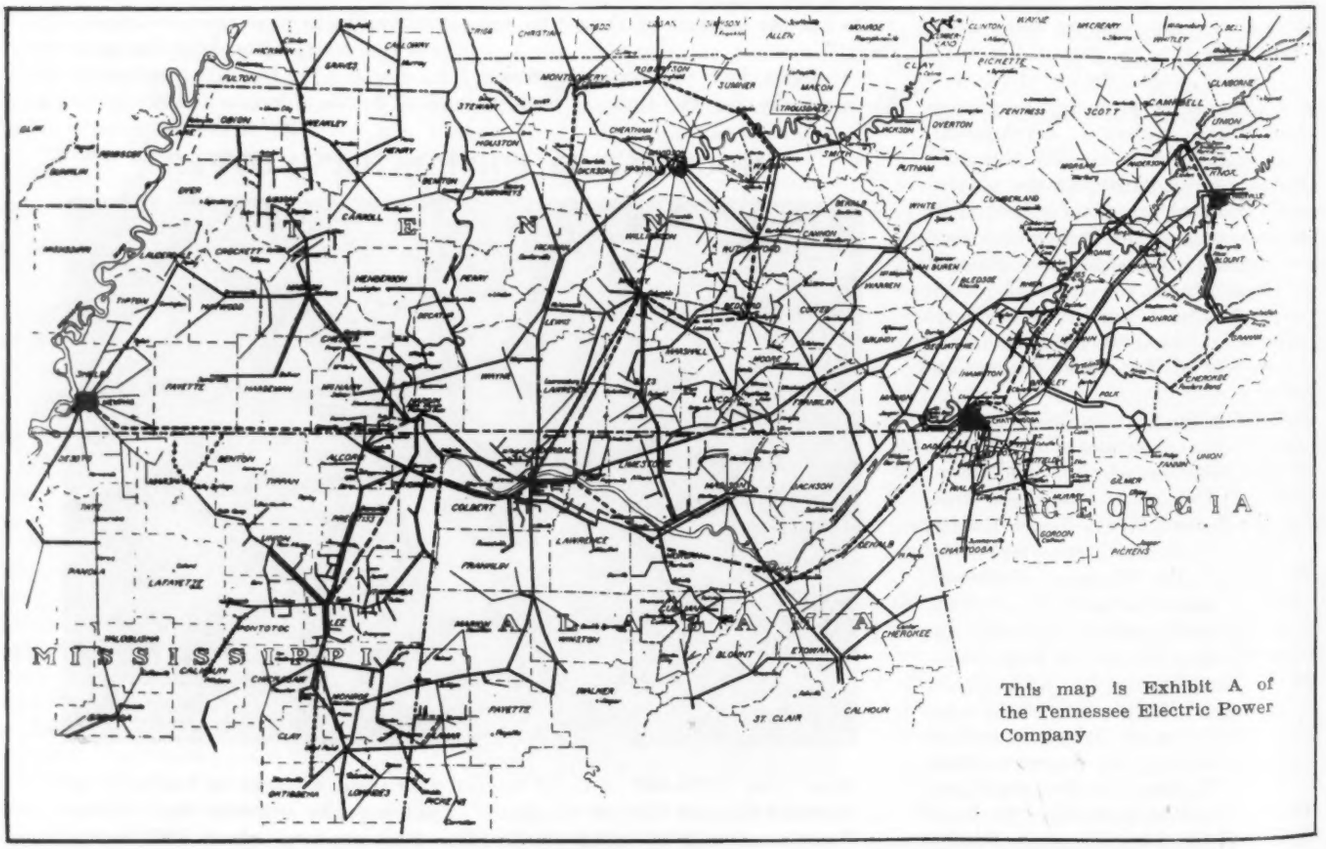
Each passing week now sees the Tennesse Valley Authority working at top speed to construct competitive facilities to serve the population of 2,400,000 living within its zone of operations, while utility companies faced with ultimate confiscation are seeking and securing from the courts at least temporary protection.

Within the last ten days major developments have taken place at Memphis, Knoxville and Chattanooga which indicate that the companies are now determined to force T.V.A. into a legal showdown on any one of a dozen fronts. The authority is gradually being blockaded by injunctions after its amazing expansion as shown on the map below, taken from Tennessee Electric Power Company brief of August 19.

At Memphis, August 18, the City Light and Water Commission abruptly broke off negotiations with Memphis Power & Light to purchase the property (ELECTRICAL WORLD, May 16, 1936, page 5).

The company has now filed suit to enjoin the city from building a competing distribution system. The suit strikes also at the T.V.A. proposal on the ground that if the contract is carried out it would constitute an "abdication and surrender" by the city and state of their sovereign and governmental rights. It contends that the city would be powerless to fix rates and prescribe regulations and means of maintaining the distribution system, and also attacks the authority of the T.V.A. to furnish the city power which, it claims, is not power generated incidental to a proper governmental function of navigation and flood control but power which constitutes an outright sale. The suit further asks that the city be enjoined from going ahead with the sale of $3,000,000 in bonds with which to start its distribution system.

Immediately following the filing of the suit, W. J. O'Brien, president of Memphis Power & Light Company, issued a statement giving the background of the litigation and regretting that the city declined to avail itself of the company's offer to distribute T.V.A. power. Mr. O'Brien said: "This would have resulted in an im-



Map shows dams, transmission and distribution systems in government's T.V.A. area

mediate saving to the ratepayers of more than $1,000,000 annually and the purchase from T.V.A. of at least twice as much power as the city's minimum guarantee to T.V.A."

This case will be heard before Chancellor John Swepson on September 18, and each party states that the Chancellor's decision will be appealed. Two cases are now pending in the District of Columbia and in the federal courts to halt P.W.A. funds for Memphis.

At Chattanooga three small landowners have replied to T.V.A. condemnation proceedings by a bill alleging T.V.A. has no right to build the Chickamauga Dam near Chattanooga. It is expected that if the landowners' contentions are upheld by the court the construction of the $32,000,000 dam would be blocked.

The landowners, F. S. Maddox, Ollie Maddox and W. T. Maddox, who are in the federal court fighting efforts of the T.V.A. to obtain land for the project, allege in their answer that the object of the dam is to produce electric energy and not to aid navigation, flood control or national defense, and they further claim that the act creating the T.V.A. is unconstitutional and void to the extent that it authorizes the authority to build dams, power houses, etc., for the primary purpose of producing electricity for the purpose of sale and profit.

At Chattanooga Chancellor Lon Foust has postponed for one month hearings on Tennessee Electric Power Company's plea for permanent injunction against the proposed $8,000,000 municipal distribution system.

At Knoxville Judge George Taylor has disqualified himself in the suit of nineteen companies against T.V.A. and his successor, Federal Judge John Gore, has allowed T.V.A. until September 5 to file briefs and affidavits in answer to an action which will probably halt much of the authority's power program.

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Danville Applies to State for Dan River Dam License

Application has been made by the city of Danville, Va., to the State Corporation Commission for a license under the water power act for construction of the dam at the Dan River pinnacles, G. C. Boyer of the utilities division of the commission announced last week. The application stated that federal authorities had examined the project and given the opinion that since it would not influence interstate commerce on the river, the federal government was without jurisdiction.

The state commission has set September 28 as the date on which an open hearing will be held on the application to proceed with the building of the dam after spending $230,000 in preparatory work.

Report Shows T.V.A. Methods of Attack

Government agents take three large power customers, trail line crews, push private poles aside to string government copper in Alabama.

An amazing disclosure of specific attacks made by the Tennessee Valley Authority upon utility companies is contained in the motion for preliminary injunction filed last week by the Tennessee Electric Power Company.

Three examples are given of large power customers who are deserting privately owned utilities for lower rates, coupled in one case with fear that the contract rates offered by the Tennessee Electric Power Company are insecure. Details of these examples, given below, reveal a new light on ways and means being taken by our governmental agents to sack a going American business.

Reminiscent of frontier days in the wild and woolly West are tales of competition in the construction of rural lines.

"For example, on July 24, 1936," says the brief, "Alabama Power Company began to stake out a line from Vinemont to West Point. In less than an hour after this work had commenced, the defendants (T.V.A.) began work in the same location with a crew of more than 100 T.V.A. employees who proceeded to dig holes and set poles within a few feet of the poles being erected by the Alabama Power Company. On the same afternoon defendant's crews began stringing wires, which in some instances touched the tops of the Alabama Power Company's poles."

Another case cited tells of T.V.A. stringing copper on the Vinemont-Centreville highway only after the T.V.A. had pushed aside poles erected by the company.

With regard to the loss of three large power customers, the report says:

1. The Monsanto Chemical Company is a large corporation engaged in the business of manufacturing and selling various classes of chemicals. It has had a plant in Anniston, Ala. In recent months it decided to construct a very large plant in Maury County, Tenn., a few miles from Columbia. It requires for its purpose a great deal of electric power, and when it begins operation in Maury County it will be one of the largest power users in the State of Tennessee. Negotiations were had between the complainant, the Tennessee Electric Power Company, and Monsanto for supplying this power. Satisfactory terms were arrived at, but Monsanto Chemical Company advised the Tennessee Electric Power Company that it considered said company's situation so precarious on account of Tennessee Valley Authority competition that it could not run the risk of relying on a contract with said company unless the contract were properly secured. The Tennessee Electric Power Company thereupon offered to secure Monsanto Chemical Company by depositing $1,500,000 of its first mortgage bonds. This offer was declined in a telegram which stated:

"Due to the unfortunate competitive conditions surrounding The Tennessee Electric Power Company, our directors are unwilling to hazard a several-million-dollar investment whose success is entirely dependent upon the continuity of its power supply at contract rates which we believe are insecure, without a guarantee from the Commonwealth & Southern."

Shortly thereafter, on May 19, the

WAITING TO ENTER ONE OF 200

More than 200 homes such as this one in Decatur, Ga., have been completed and opened by General Electric Company this year as a part of its demonstration electric home program

Monsanto Chemical Company announced that it had arranged to purchase its power from defendants, and since that time the defendants have commenced the construction of a 154,000-volt line from Wheeler Dam to Columbia, for the purpose of furnishing power to Monsanto Chemical Company.

2. Volunteer Portland Cement Company is a large industrial user of electric power. It owns and operates a modern cement plant approximately 5 miles east of the city of Knoxville, Tenn. For a number of years it has been served by complainant, Tennessee Public Service Company, with which it has a contract to purchase its electrical requirements. Within the last 60 or 90 days the defendants' agents solicited said company to enter into a contract to purchase all of its power from Tennessee Valley Authority at rates very much lower than the rates which it is now paying Tennessee Public Service Company. On July 30, 1936, Tennessee Public Service Company received written notice from Volunteer Portland Cement Company of the cancellation of its present contract, and that after April 15, 1937, said company would purchase its power requirements from T.V.A.

3. Saratoga Victory Mills is a corporation of Alabama which owns and operates two cotton mills in Marshall County, Alabama. One of these mills is located in Albertsville and the other is located in Guntersville. Both of these mills now purchase power under contract from complainant, Alabama Power Company, having an approximate annual consumption of more than 7,700,000 kw.-hr. On June 16, 1936, the city of Guntersville made a proposal to Saratoga Victory Mills to furnish T.V.A. power to both mills at T.V.A. wholesale rates.

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Georgia Power Works With R.E.A. Systems

Georgia Power Company will make the services of its engineers available without charge to groups seeking R.E.A. loans, it has been announced by President Preston S. Arkwright.

In addition the company will, if requested, repair and maintain rural lines for co-operatives, thus placing at their service the Georgia Power Company's large and expertly trained operating force. This service will be rendered at its actual cost to the company. On the same basis, the company will answer trouble calls to the homes of individual consumers to repair electric appliances, and will provide meter reading and billing services.

The Georgia Power Company has already filed with the Public Service Commission a schedule of rates providing for wholesale electric service to co-operatives. They have been indorsed by R.E.A. as reasonable.

President Arkwright stated that the company would not build rural lines to serve part of a county or section which had applied or intended to apply for an R.E.A. loan if by so doing it would endanger the success of the local project. On the other hand, he said, the company is not offering its cooperation to organizations formed solely for the purpose of destructive competition in areas which the Georgia Power Company is already serving or is prepared to begin serving.

Meetings

Illuminating Engineering Society — Annual convention, Statler Hotel, Buffalo, N. Y., August 31-September 3, A. D. Cameron, general secretary, 29 West 39th Street, New York.

Third World Power Conference—Washington, D. C., September 7-12. Joel Wolfsohn, executive secretary, Interior Building, Washington, D. C.

International Association of Electrical Inspectors—Western section, Brown Hotel, Louisville, Ky., August 31-September 3; Eastern section, Hotel New Yorker, New York, September 8-10; Northwestern section, Olympian Hotel, Olympia, Wash., September 14-16; Southwestern section, Hotel Fresno, Fresno, Calif., September 21-24; Southern section, Hotel Adolphus, Dallas, Tex., September 28-October 1.

Pennsylvania Electric Association—Annual meeting, Bedford Springs Hotel, Bedford Springs, Pa., September 9-11. Harold A. Buch, secretary, Telegraph Building, Harrisburg, Pa.

National Electrical and Radio Exposition—Grand Central Palace, New York, N. Y., September 9-19, Ralph Neumuller, secretary, 480 Lexington Avenue, New York, N. Y.

Maryland Utilities Association—Mid-year meeting, George Washington Hotel, Ocean City, Md., September 12. E. J. Hand, secretary, Clayton Building, Elkton, Md.

West Virginia Public Utilities Association—Annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., September 18-19.

Rocky Mountain Electrical Association—Annual convention, Santa Fe, N. M., September 21-23. George E. Lewis, managing director, Gas and Electric Building, Denver, Colo.

Association of Iron and Steel Engineers—Annual convention, Detroit, Mich., September 22-25. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.

National Electrical Wholesalers Association — Semi-annual convention, Hotel Statler, Buffalo, N. Y., September 28-30. E. Donald Tolles, managing director, 165 Broadway, N. Y.

Empire State Gas & Electric Association—Annual meeting, Saranac Inn, N. Y., October 1-2. C. H. B. Chapin, secretary, Grand Central Terminal, New York, N. Y.

Indiana Electric Association — Annual convention, French Lick, Ind., October 1-2. T. C. Polk, secretary-treasurer, 609 Traction Terminal Building, Indianapolis, Ind.

National Electrical Manufacturers Association—Netherland Plaza Hotel, Cincinnati, Ohio, October 4-10. W. J. Donald, managing director, 155 E. 44th Street, New York.

Electrochemical Society — Fall meeting, Niagara Falls, Ontario, October 7-10. Colin G. Fink, secretary, Columbia University, New York, N. Y.

California Companies to Interchange Power

Southern California Edison Company and San Joaquin Light & Power Corporation have been granted permission to interchange power for a period of ten years by the California Railroad Commission and they will construct two transmission systems at a cost of $1,300,000 to transfer power from the Edison company to the San Joaquin organization.

The proceedings before the Railroad Commission attracted wide attention throughout the West because the $170,000,000 Central Valley project sponsored by the government was placed in jeopardy by the more economical and more efficient interchange agreement reached by the two utility companies.

While the commission took no direct action upon the plea of Central Valley project proponents that statutory laws be invoked to protect it against the operation of economic laws, it has reserved jurisdiction in approving the new contract so that it may order such changes or modifications in the contract as may become necessary to safeguard the water project.

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Government Speeds Seattle-Skagit Job

Immediate construction of Seattle "City Light's" $2,500,000 transmission lines between the Skagit hydro-electric development and Seattle was requested of the City Council by Superintendent of Lighting J. D. Ross. Clearing and grubbing of 30 miles of the right-of-way in King County is contemplated, Ross stated, in a Works Progress Administration project estimated to cost $99,375. Ross asked the Council to appropriate $11,680 toward this work and the construction of foundations for the transmission line towers, with the understanding that the W.P.A. would furnish the labor, estimated at $87,695. Ross stated the city utilities' load is increasing so rapidly the lines must be constructed as soon as possible.

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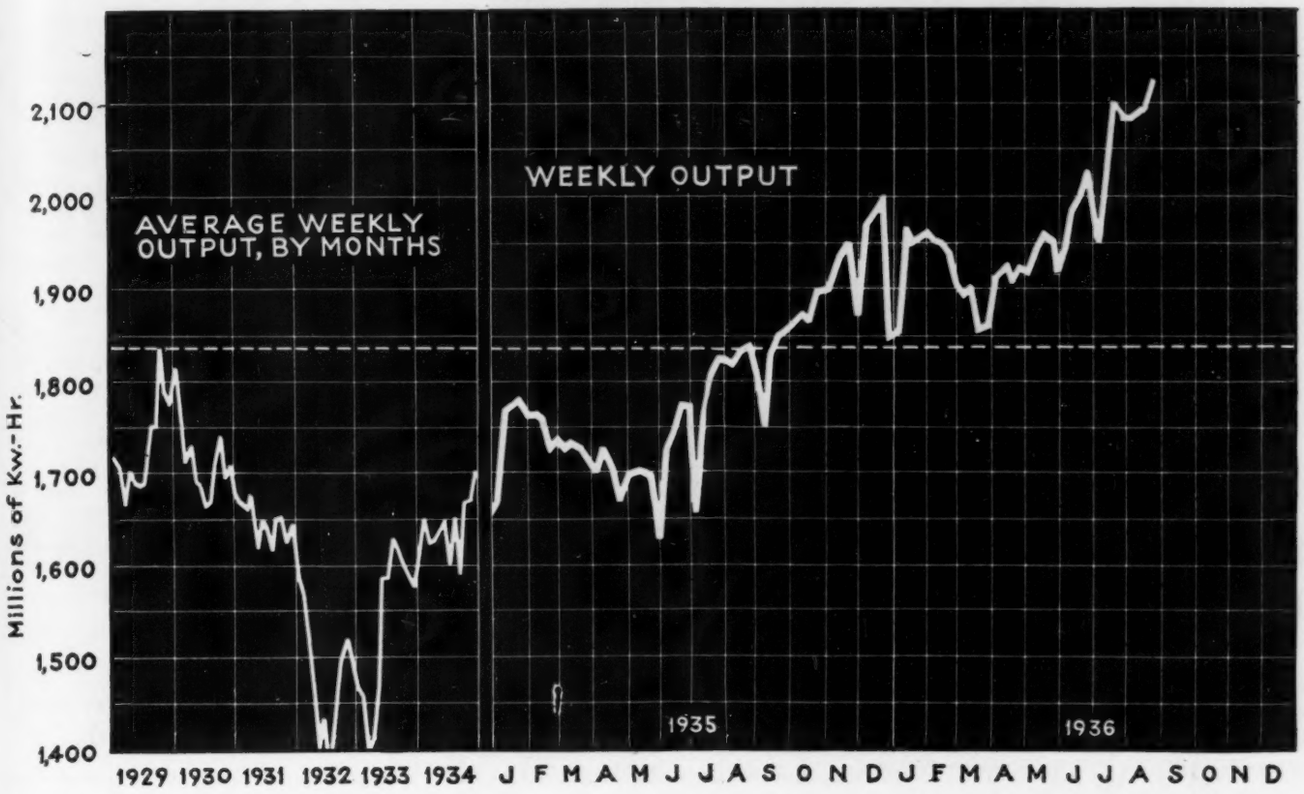
Housewares Display Prizes

A total of $400 in cash prizes will be given away to winners in the nationwide electrical housewares display contest to be sponsored by the Edison Electric Institute and twelve leading electrical manufacturers during October. Dealers and distributors throughout the country are to take part in Electrical Buffet Service Month, a national sales promotional activity designed to demonstrate to housewives the advantages of electric table cookery in buffet serving.

Output Again Breaks Record



For the fifth time since the middle of June this year the output of electric light and power companies has established a new record. This time the week ended Saturday, August 22, finds the output at 2,125,502,000 kw.-hr., according to the Edison Electric Institute. This figure represents an increase in output of 21.5 per cent over the corresponding week of 1929 and an increase of 6.2 per cent over the December peak of 1935.

No signs of a recession in output are evident as business throughout the country continues active. In fact, continued increases in output can be expected in succeeding weeks.

Increases in the regional gains are to be noted in all sections. Recent decreases in the Central Industrial and West Central regions have been recovered considerably.

Weekly Output, Millions of Kw.-Hr.

1936	1935	1934
Aug. 22... 2,125	Aug. 24... 1,810	Aug. 25... 1,648
Aug. 15... 2,094	Aug. 17... 1,833	Aug. 18... 1,674
Aug. 8... 2,079	Aug. 10... 1,819	Aug. 11... 1,659
Aug. 1... 2,079	Aug. 3... 1,821	Aug. 4... 1,658
July 25... 2,088	July 27... 1,824	July 28... 1,684
July 18... 2,100	July 20... 1,807	July 21... 1,664

Per Cent Change from Previous Year

	Week Aug. 22	Week Aug. 15
New England	+15.0	+14.7
Middle Atlantic	+14.6	+13.3
Central Industrial	+18.4	+17.1
West Central	+16.4	+13.1
South States	+20.4	+18.7
Rocky Mountain	+14.1	+12.8
Pacific Coast	+10.6	+8.6
United States	+15.5	+14.3

Low Water Affects Plants and Mills

Low water, bugaboo of the hydro station operator, is giving utility men in many parts of the country plenty to think about these days. It may, in fact, be causing even the government's hydro protagonists to pause and think. Rainfall since the first of the year has been light, with the exception of the flood period, and as a result hydro stations have been running an up-hill race with that steep line on the output chart. Water-power generation for June showed a decline of 6 per cent from the 1935 level, while fuel generation climbed 33.5 per cent.

Utility and industrial plants along the Connecticut River that but five months ago "took it on the chin" as that temperamental stream went on a rampage now find the flow at its lowest in five years. Noon of August 21 found 40 mills at Holyoke, Mass., losing water power and starting operations on power purchased from the Holyoke Water Power Company and the Holyoke municipal plant. These conditions exist in a region where rainfall this year equals the 30-year average. Most of it, however, came in the early spring.

Frank J. Boehm, vice-president of the Union Electric Light & Power Company, St. Louis, Mo., reports that low water on the Osage and Mississippi Rivers is forcing the company to operate its hydro-electric plants at Bagnell and Keokuk at reduced output and to rely primarily on its steam plant at Cahokia, Ill. Bagnell was reported as supplying about one-tenth the desired output, while Keokuk is producing about half that possible in normal times. On August 22 the Mississippi was at an all-time low for August of 3.7 feet below zero on the gage at St. Louis. Normal for August is 11.2 feet above zero.

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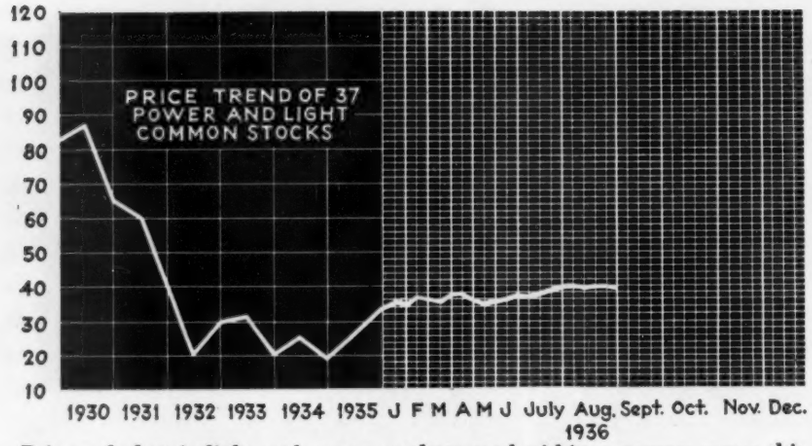
Readjustment Plan Approved

At a meeting of prior preferred and preferred stockholders of Mississippi Valley Utilities Investment Company the plan for readjustment of capitalization was approved. Present prior preferred stock will hold 92 per cent and present preferred stock 8 per cent of the new shares. Readjustment is for the purpose of accomplishing liquidation.

Utility Stocks Recede Slightly



Prices of electric light and power stocks moved within a narrow range this week. Slight losses were sufficient to carry the "Electrical World" index down to 38.6; last week, 39.4

Refunding Recovers From Seasonal Slump

Public utility financing continues almost entirely of refunding operations and is confined to those companies which are not directly affected by federal power projects. Very little new capital is finding its way into the industry, although large amounts are needed for construction and expansion of facilities. Punitive legislation has had a disquieting effect on the companies and capital.

Offering this week was made of $35,000,000 Cincinnati Gas & Electric Company first mortgage 3¼ per cent bonds, due 1966. The price to the public is 102, exclusive of accrued interest, to yield 3.14 per cent to maturity. Proceeds will be applied toward redemption of all the first mortgage 4 per cent series A bonds on October 1 at their principal amount and accrued interest. The amount required for such purposes is $35,700,000, of which $700,000 is interest, and any balance required for this aggregate amount will be provided from company funds.

Another offering this week was the $7,000,000 Central Vermont Public Service Corporation first mortgage 3½ per cent bond issue, series B. The bonds mature August 1, 1966, and are priced at 101⅞ and accrued interest. Proceeds of the financing are to be used primarily for retirement of outstanding higher coupon bonds.

Refinancing plans involving issuance of $7,500,000 25-year 3½ per cent debentures and $7,000,000 30-year 3½ per cent mortgage bonds, replacing higher rate bonds now outstanding and calling present 6½ per cent preferred stock, are projected by Connecticut Light & Power Company. The financing will furnish additional capital which will provide for the installation of a 25,000-kva. turbine at the Montville power station and other work. As a result of the financing the company will effect an annual saving of approximately $240,000.

The Ohio Public Utilities Commission has authorized the Toledo Edison Company to issue and sell at par $3,000,000 six-year 4 per cent bonds. Pending their sale the bonds were authorized to be pledged as security for a five-year 4 per cent note dated August 1, last, for $3,000,000.

Detroit Edison Company has filed a statement with S.E.C. covering $20,000,000 of general and refunding mortgage bonds, series G, due September 1, 1966. The interest rate is to be furnished by amendment to the registration statement. Proceeds will be used to retire outstanding higher coupon bonds.

Washington Gas Light Company has filed a registration statement for 130,000 shares of its capital stock.

Huge Outlays Needed for Alabama Power

Engineers have found that $525,000,000 of new capital would be needed for new developments which would have to be made over a period of twenty years to meet the demands on the Alabama Power Company for power and service, Thomas W. Martin, president of the company, said in addressing a Birmingham civic club last week. Of this amount $268,000,000 would go for labor, Mr. Martin added.

Mr. Martin said one of the present problems of the Alabama Power Company is the threat of government in business, illustrating the point with the T.V.A. He said that if the Alabama Power Company could refinance its $140,000,000 of preferred stocks and bonds at interest rates now in force it could save $2,000,000 a year, but that the threat of government in the power production and distribution business made refinancing impossible at present.

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Utility & Industrial Corporation Increases Net Worth

Net worth of Utility & Industrial Corporation as of June 30, 1936, based on values as reflected in the statement of investments, increased $821,527.23 over December 31, 1935, and was equivalent to $5.50 per share of convertible preferred stock on June 30, 1936.

The six months report shows gross income of $29,597.63; operating expenses and interest charges of $28,785.43, which resulted in a profit from operations exclusive of net charges to capital surplus, of $812.20. Notes payable were reduced from $649,000 to $462,000 on June 30, 1936.

Utility Earnings Reports

Company	Net Income 1936	1935
American Public Service		
June 30 quarter	$63,395	$3,525
Six months, June 30	45,693	(a)93,255
Central & South West Utilities		
June 30 quarter	371,665	(a)266,724
Six months, June 30	651,484	(a)588,922
Cleveland Electric Illuminating		
Twelve months, June 30	6,990,545	5,290,591
Columbia Gas & Electric		
June 30 quarter	2,349,976	2,635,346
Twelve months, June 30	12,945,118	9,857,310
Detroit Edison		
(b) Twelve months, July 31	11,047,460	5,577,390
Duquesne Light		
Twelve months, June 30	10,704,462	9,826,965
Kansas City Power & Light		
Twelve months, June 30	3,814,776	3,367,161
Kansas City Public Service		
Seven months, July 31	4,522	(a)282,594
Twelve months, July 31	(a)103,412	(a)419,682
Kentucky Utilities Co.		
June 30 quarter	331,341	243,896
Six months, June 30	627,674	574,347
Louisville Gas & El. Co. of Del.		
Twelve months, June 30	1,690,799	1,325,322
Mississippi River Power		
Twelve months, June 30	1,758,180	1,536,490
Northern States Power		
Six months, June 30	$2,955,834	$2,783,614
Twelve months, June 30	5,529,839	4,976,337
Pacific Gas & Electric		
Twelve months, June 30	22,938,850	18,153,431
Public Serv. of Okla. & Subs.		
Four months, April 30	446,157	.....
Public Service Corp. of N. J.		
Twelve months, July 31	23,174,109	24,339,991
Southern Colorado Power		
Twelve months, June 30	170,064	170,079
Southwestern Gas & Electric		
June 30 quarter	437,582	269,861
Six months, June 30	779,137	502,897
Southwestern Light & Power		
June 30 quarter	37,112	6,906
Six months, June 30	186,068	73,790
Union Elec. Light & P. of Ill.		
(b) Twelve months, June 30	2,520,044	2,487,256
Union Elec. Light & P. of Mo		
Twelve months, June 30	6,867,200	5,282,072
Wisconsin Gas & Electric		
(b) Twelve months, June 30	609,287	314,685

(a) Net loss. (b) Report subject to audit and year-end adjustments.

Manufacturing AND MARKETS

I.E.S. Lamp Campaign Launched

A two weeks free trial offer to customers is the novel feature of an intensive I.E.S. lamp campaign which opens in the New York area September 1 and continues for three months. The six electric companies of Consolidated Edison System, some 450 dealers and seven manufacturers will co-operate in a campaign designed to bring better light to metropolitan homes and better revenues to electric merchandisers.

Under the free trial plan purchasers may try out lamps in their own homes or places of business for two weeks without cost. If the lamp is retained the owner may pay for it in monthly installments of one dollar beginning at the end of the trial period. If the purchaser wishes to return the lamp after the trial, the dealer from whom it was purchased will pick it up and return it to the manufacturer.

Three types of lamps were chosen for the campaign—the table study, end table and floor model lamps, to retail at $4.75, $5.95 and $6.95, respectively. Each lamp is equipped with a 100-watt Mazda bulb.

Details of the drive were outlined by E. F. Jeffe, assistant vice-president New York Edison, to some 400 dealers and participating manufacturers who met with the Electrical Association of New York last week. J. F. Becker, vice-president of New York Edison, addressed the meeting and Henry Obermeyer, assistant to the executive vice-president of Consolidated Edison Company, described the extensive advertising campaign to be conducted through newspapers, radio, billboard, pamphlets and bill inclosures.

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Signal Electric Plans $20,000 Plant Addition

Announcement was made at a recent directors' meeting that the Signal Electric Manufacturing Company, Menominee, Mich., will build a two-story addition to its plant that will cost $20,000. Construction will begin this month. Increased demand for Signal fans, fractional-horsepower motors, drills and other Signal products, which necessitates a longer peak production, is the reason for the expansion.

•

Westinghouse Adds 13% to Employees' Pay

Employees of the Westinghouse Electric & Manufacturing Company, including 5,000 in the East Springfield plant, have received an additional payment of 13 per cent of their July wages or salaries under the company's new plan of wage adjustments based on profits. The award was the third disbursement made under the new plan. The May adjustment amounted to 9 per cent and that of June, 11 per cent, according to L. E. Osborne, Springfield works manager.

Electroline Acquires Fiege Patents

Exclusive license to manufacture and sell in the United States and in all foreign countries, except those in the United Kingdom, wire and stranded cable termination devices covered by the H. C. Fiege patents has been granted by the Fiege Company, Green Bay, Wis., to the Electroline Company, Chicago, Ill.

The patents, applying to a novel method of holding the ends of stranded metal cables by bending them over or around and/or passing them through a metal plug inclosed in a steel body, cover a large diversity of forms of the device. It is the intention of the Electroline Company to manufacture and market first those sizes and forms applicable to wire rope and stranded

UP SHE GOES, AT TRI-BOROUGH BRIDGE

Acme

From this central control room traffic signals are changed to red, safety gates are closed and locked and Tri-Borough's 2,000-ton span is started upward. Three sources of power are provided to avoid breakdowns

cable up to ⅝ in. diameter. For overhead line construction the devices will be particularly useful in dead-ending conductors and making guy attachments. The Electroline Company expects to make commercial announcement of these new products in a short time.

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McGraw Electric Nets $701,710

Report of McGraw Electric Company for twelve months ended June 30 shows net profit of $701,710 after depreciation and provision for normal federal income taxes, and including credit of $22,200 resulting from adjustments of reserves and accruals set up in prior years, equal to $2.96 a share on 236,696 shares of capital stock outstanding, exclusive of treasury stock. In preceding twelve months net profit was $536,792 after above charges, and including a credit of $40,848 resulting from adjustments of reserves and accruals set up in prior years, equal to $2.27 a share on capital stock.

Current assets as of June 30, including cash of $863,960, amounted to $1,901,817, against current liabilities of $256,301.

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Midtown Tunnel Bids Opened

The Port of New York Authority, New York, N. Y., has low bid from J. Livingston & Company, Graybar Building, for electrical installation in the new Midtown Hudson Tunnel between New York and New Jersey, at $948,367, covering electric lighting system, traffic control and fire alarm systems, telephone system, supervisory control system for power supply and distribution systems, and miscellaneous auxiliary work. Bids were closed on August 4. Work under the contract is stipulated to be completed in September, 1937.

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Allis-Chalmers Laboratory

Allis-Chalmers Manufacturing Company, West Allis, Wis., has taken bids on general erection of a three-story laboratory and engineering office building at its plant, with first floor, 60x200 ft., and two upper stories, 60x100 ft.; and will begin construction early in the fall. It will cost over $75,000 with equipment.

New York Metal Prices

	Aug. 19, 1936 Cents per Pound	Aug. 26, 1936 Cents per Pound
Copper electrolytic	9.75*	9.75*
Lead, Am. S. & R. price	4.60	4.60
Antimony	10.875	11.37
Nickel ingot	35.00	35.00
Zinc spot	5.175	5.175
Tin Straits	42.10	42.00
Aluminum, 99 per cent	19—21	19—21

*Delivered Connecticut Valley.

Field Reports on Business

Reports to the ELECTRICAL WORLD *from the field show that business has measured up to the most optimistic predictions throughout August—there hasn't been any summer let-down and the outlook is for further material improvement after Labor Day. The most impressive statistical confirmation of that trend continues to come from the steel and electric energy output figures.*

NEW YORK

Business approaches the end of August spinning along in high gear and hopes to accelerate to really impressive speed right after Labor Day for the first time in nearly six years. The momentum is accumulating—steel operations are up to the highest point of the year, electric energy production has attained another all-time peak, automobile companies are rushing to get back into production as early in September as possible, and most distributive lines are confident they will have the best autumn since 1930.

So brisk is the pace at which orders are being placed that many lines are falling behind on deliveries. The steel industry is a shining example. Much mill capacity is booked right through to the end of September and customers are specifying against orders more actively than was anticipated a month ago. While steel ingot output is 72½ to 73 per cent of capacity, finishing mills are running from 80 to 100 per cent. Long idle blast furnaces are being fired to step up ingot capacity. Great Lakes steamers are rushing ore down from the Superior ranges.

This swelling boom in industry is directly reflected in this new high in electric energy production—industrial power use this fall will certainly top 1929 (if it hasn't already). Domestic load, meanwhile, continues to soar with residential building, providing a fertile market for electrical equipment and appliances.

The distinct firmness of metal prices, much heavier demand now placed on heavy industry and disappearance of skilled labor all are contributing to the problem utilities will face when the rush for new generating capacity comes.

NEW ENGLAND

Continuing along the high level of sales of electrical equipment reported for this district during the first half of August, the past week recorded wide diversification of orders well above the volume registered during a similar period of a year ago. Heavy electrical power machinery and control apparatus sales for naval needs are active, as are also small motor sales. Some single motors (one of 125 hp. for a new installation, together with automatic electric control) for pumping service have been bought lately.

Small distribution transformers are in steady demand; one well-known representative reports inquiries during the past month and encouraging sales which are an aftermath of the gradual upturn in energy demand from the increased use of domestic appliances. Electric illumination is active; one maker is completing 84 floodlight units for the Polo Field, New York. The Quincy Electric Light & Power Company has ordered 500 new No. 79 G.E. "Acorn" street lighting units for main traffic highway illumination in Quincy, Mass. Store-lighting fixtures are selling well.

The general business tone in this district is sound: the New England Power System output is 21.8 per cent over that of a year ago; outdoor metering is gaining in this district; public interest in complete electric kitchens is strong and new housing is moving at considerable pace. Merchandising is steady; 350 apartment ranges were sold in the Boston Edison area in the past two months; electric refrigerator sales and water heating installations are growing appreciably in this area.

PACIFIC COAST

Wholesalers report excellent sales of all classes of material to all classes of customers, especially of roughing-in material to electrical contractors. They are vigorously battling to raise the standard of wiring devices and lighting fixtures in the multiple group construction of cheap tract or subdivision residences now so prevalent, because sales of quality wiring staple are disproportionately low. A feature of 1936 electrical business has been overlapping of seasonable merchandise, evidenced by duration of pumping and fan seasons and consequent shipping delays.

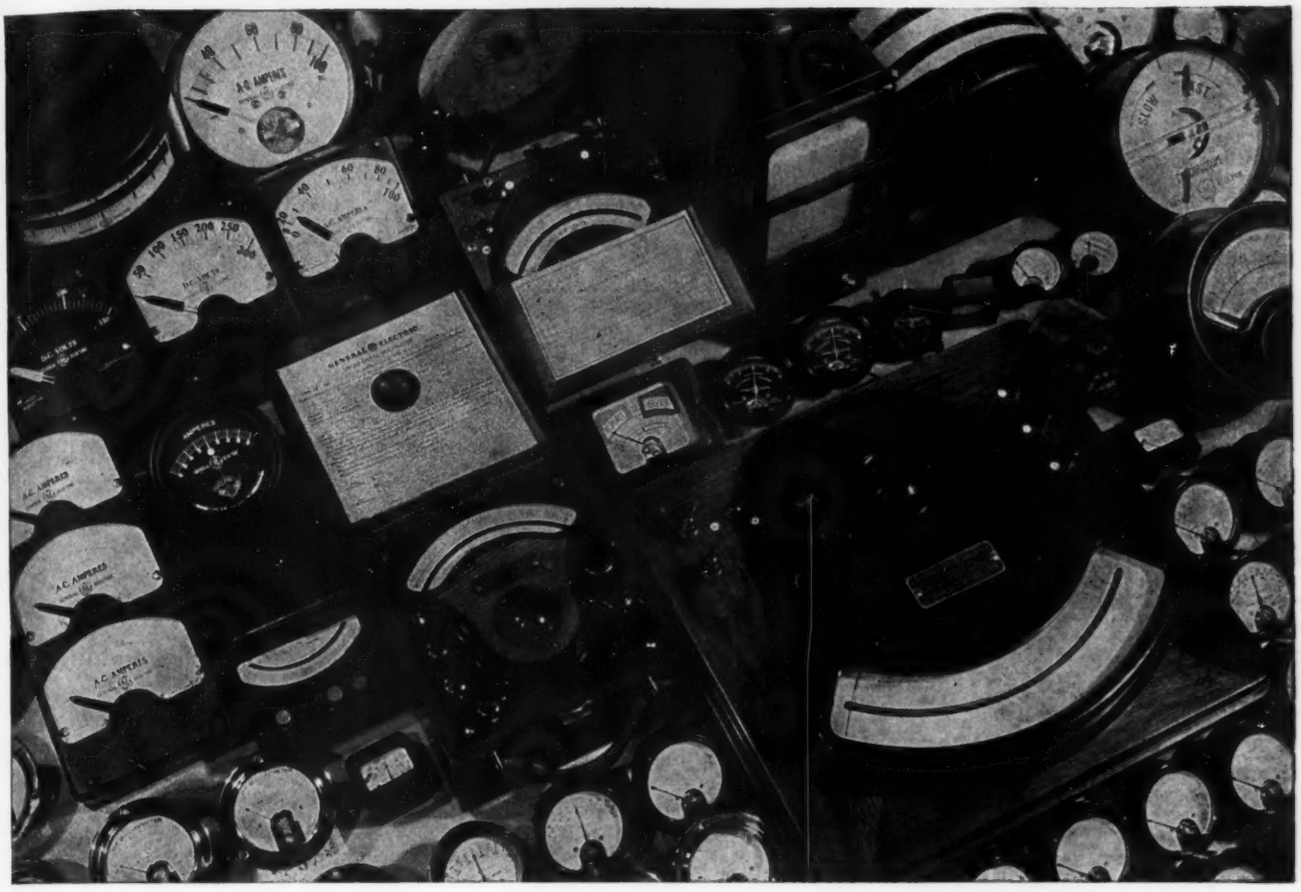
San Francisco's $25,000,000 appropriation request for rapid transit and subway system, involving huge electrical expenditures, is reported as progressing favorably in its preliminary Washington hearings. Conferences are now proceeding relative to September renewal of longshoremen labor agreements, with prospective extension of leftist policies to the entire coast, but with a rather more favorable general labor outlook. City industrial activity is slowly increasing and marked by the gradual return of small specialized shops. Steel, cement, lumber and other basic material industries are busy. Seasonable industrials, such as fruit packing and canning plants, spray chemicals, isolated sawmills and dredger communities, are topping 1929 figures.

CHICAGO

Activity in the electrical industry continues to mount steadily through a normally slow season. Only a few brief recessions have marred the steady climb in which substantial gains have been made in practically every line. The impressive showing made by the industry this summer is cause for the increasingly optimistic attitude as autumn is approached with expectations of greater activity. Electrical energy output in the Chicago district continued at the unusually high summer level. Local utilities report a sharp upturn in earnings for July.

Wire and cable sales are especially good. The city is purchasing 500 325-watt and 200 525-watt series transformers. Order was placed for 22,000 ft. 1½-in. conduit. Installation of high-intensity mercury-vapor street lamps was made in one block of Michigan Avenue. Tests will be made to determine whether to install them the entire length of the street. There is a strong demand for floodlighting equipment for night sport events. Industrial lighting equipment sales show marked improvement.

Exceptional demand for railroad equipment continues to support the activity in local supply shops. Recent orders include ten Diesel-electric locomotives, several hundred freight cars and a number of light-weight articulated passenger coaches.



SOLVE Your Instrument Problems at HEADQUARTERS

IN every department of electrical measurement, General Electric has maintained steady progress. This advance includes methods and instruments for the accurate measurement of sound, color, magnetism, speed, thickness, and mechanical vibration, and for use in many other industrial processes.

To this work, General Electric has brought all the facilities and trained personnel of its research and general engineering laboratories, as well as the engineering departments and works laboratories at West Lynn, Pittsfield, Fort Wayne, and Schenectady.

Actually, however, the bulk of the work of these organizations in the measurement field has been directed toward the improvement of standard lines of electric instruments. Especially during the last five years, this work has been carried on intensively. As the result, General Electric now offers complete lines of instruments—five sizes of portable indicating instruments, several types of instruments for switchboard and panel mounting, recorders both portable and switchboard, laboratory standards, potentiometers, galvanometers, and others—all designed and built to high standards. Many major improvements have also been made recently in instrument transformers, both potential and current.

You benefit by making General Electric your headquarters for electrical measurement. At your disposal you have the facilities of our general engineering, research, and instrument laboratories, and also a nation-wide sales and service organization that enables you to obtain prompt service. General Electric Company, Schenectady, New York.

430-69

GENERAL ELECTRIC

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Poncho Preserves Meter Records

Utilities which use the meter readers' books for a permanent record as a part of the ledger system experience great difficulty in keeping the books dry during the rainy season. On the San Diego Consolidated Gas & Electric Company's system it was found necessary to take each meter book apart and dry and press each sheet separately after meter readers had spent the day in an unusually heavy rainstorm. This process required the services of two men working nine hours and delayed the routine billing operations of the office.

After several attempts to find a method of keeping the meter books dry, the company purchased a special light-weight rubber poncho and had a celluloid window, 11x12 in., sewed in the front at an angle which would permit the meter reader to record readings and check data without exposing the book to the elements. The shape of the poncho permits free use of the arms for opening doors, etc., but it effectively protects the meter book at all times.

When not in use the ponchos are stored in a special closet where they are suspended without folding. They are inexpensive, but pay big dividends in maintaining meter records in a legible form.

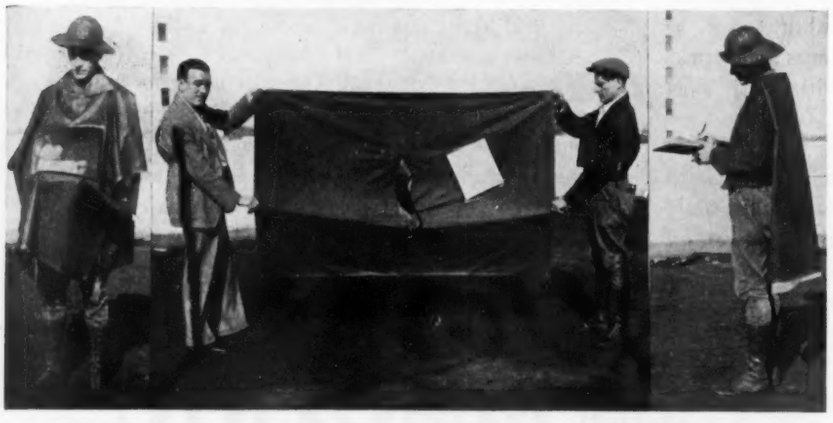
•

Drying Current Transformer Coils

An effective method of drying current transformer windings has been developed by a large Eastern utility system. About forty-five 27-kv. General Electric current transformers, type K30, had been in use twenty years and showed relatively high power factors. The method was to remove the winding of each unit from its case, placing it inside an empty oil drum from which the end had been removed. Strip heaters were then placed inside the drum and several layers of $\frac{1}{8}$-in. thick asbestos wrapped around the outside of the drum. The air temperature inside the drum was raised to about 215 deg. F.

Megger readings of the high-voltage winding to ground were taken every two hours. This winding insulation, which at first showed values of 1,000 to 1,500 megohms, rapidly dropped to as low as 30 megohms. From this low value the megger readings gradually began to rise until in about four days the curve flattened out to about 2,000 to 2,500 megohms. Four of the transformers were put through this drying, and it was continued until five megger readings of above 2,000 megohms and of the same magnitude were obtained. After the windings cooled off and had been reassembled in oil a Doble power-factor, watts-loss test set was applied and it was found that the power factors had dropped from the order of 10 to 15 per cent down to 3 per cent. Twelve windings with over 10 per cent power factor were dried out in this way.

•

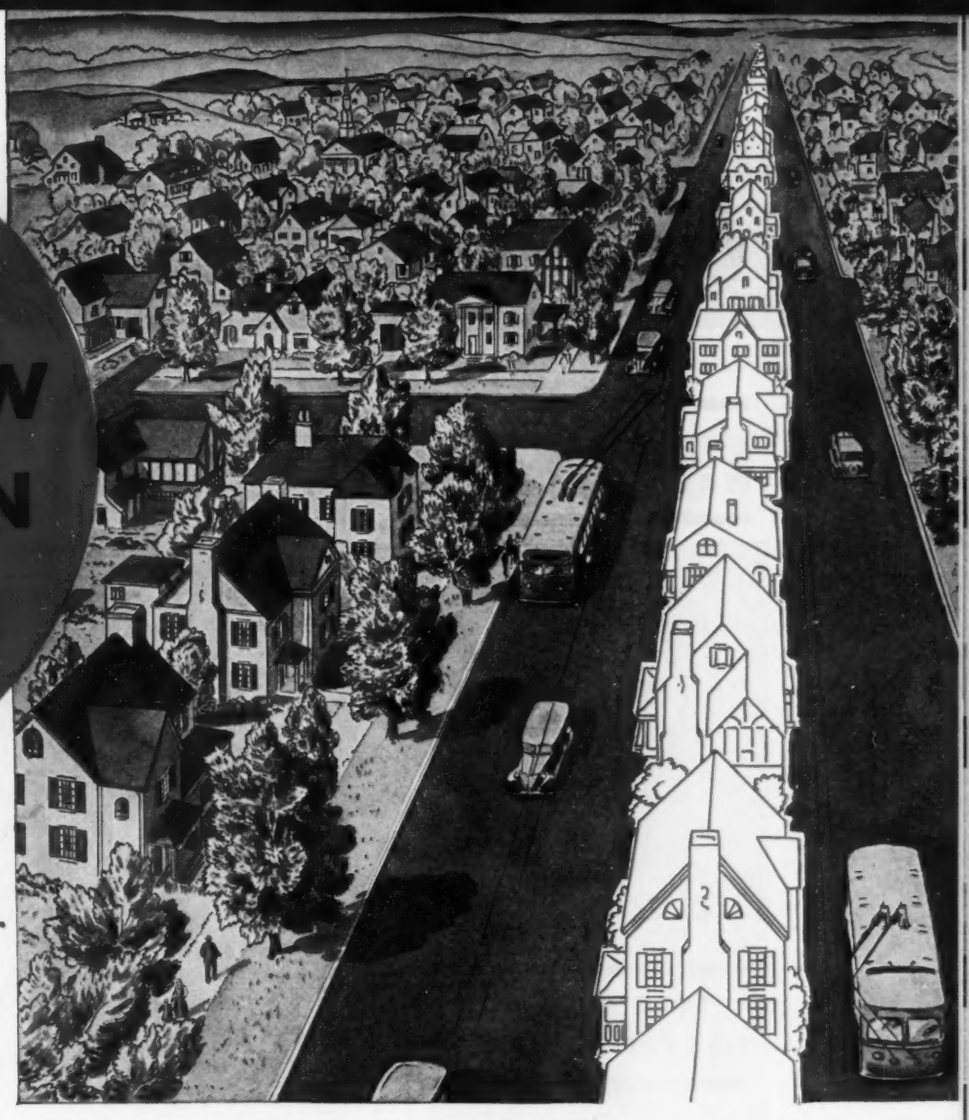


Meter reader's poncho used to protect meter books from exposure to elements

Duct Arrangements in Runs and at Manholes

While conduit runs containing only two or three ducts will generally be arranged in a horizontal plane, street conditions may force a vertical arrangement. For six or more ducts however, the standard arrangement will generally show more ducts in the vertical than in the horizontal, because generally there is more space available in vertical directions. The arrangement of more horizontal than vertical for six ducts or more will be the

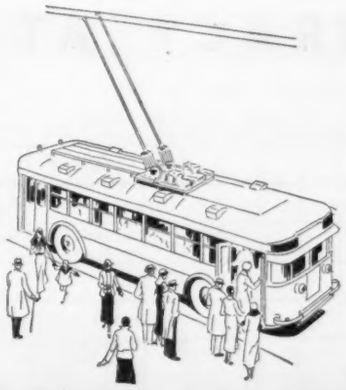
JUST LIKE ANOTHER ROW OF HOUSES IN THE STREET



HAVE YOU CONSIDERED TRACKLESS-TROLLEY LOAD IN TERMS OF EQUIVALENT REVENUE? IF NOT, IT'S TIME TO DO SOME FIGURING

FOR a rough calculation you may assume that it takes 10 trolley coaches to serve a 10-mile route. Each vehicle will use about 100,000 kw-hr a year. Make your own assumptions as to the number of homes per mile. You remember that the average domestic use in 1935 was a little less than 675 kw-hr per customer. On this basis we figure that a trackless-trolley line gives you just about as much load as half the homes along the route.

True, the domestic load carries a higher rate. But, figured in terms of revenue dollars, a 10-trolley-coach line is the equivalent of 150 water heaters, or 240 ranges, or 450 refrigerators, or 6930 washers. Yes, it takes a lot of appliance selling to fill the gap when a transit system abandons electric drive.



So, we urge more thought of the importance to you of the transportation load. We invite you to study the success of the trolley coach, which can help you preserve this load. And we suggest that among transit operators in your territory you urge the adoption of the trolley coach. You can do it without reservation. General Electric Company, Schenectady, N. Y.

232-22

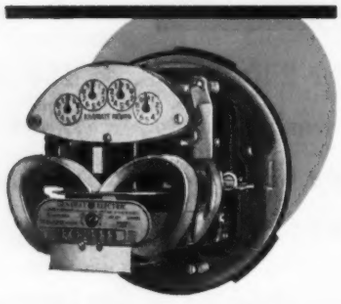
GENERAL ELECTRIC

Announcing a NEW

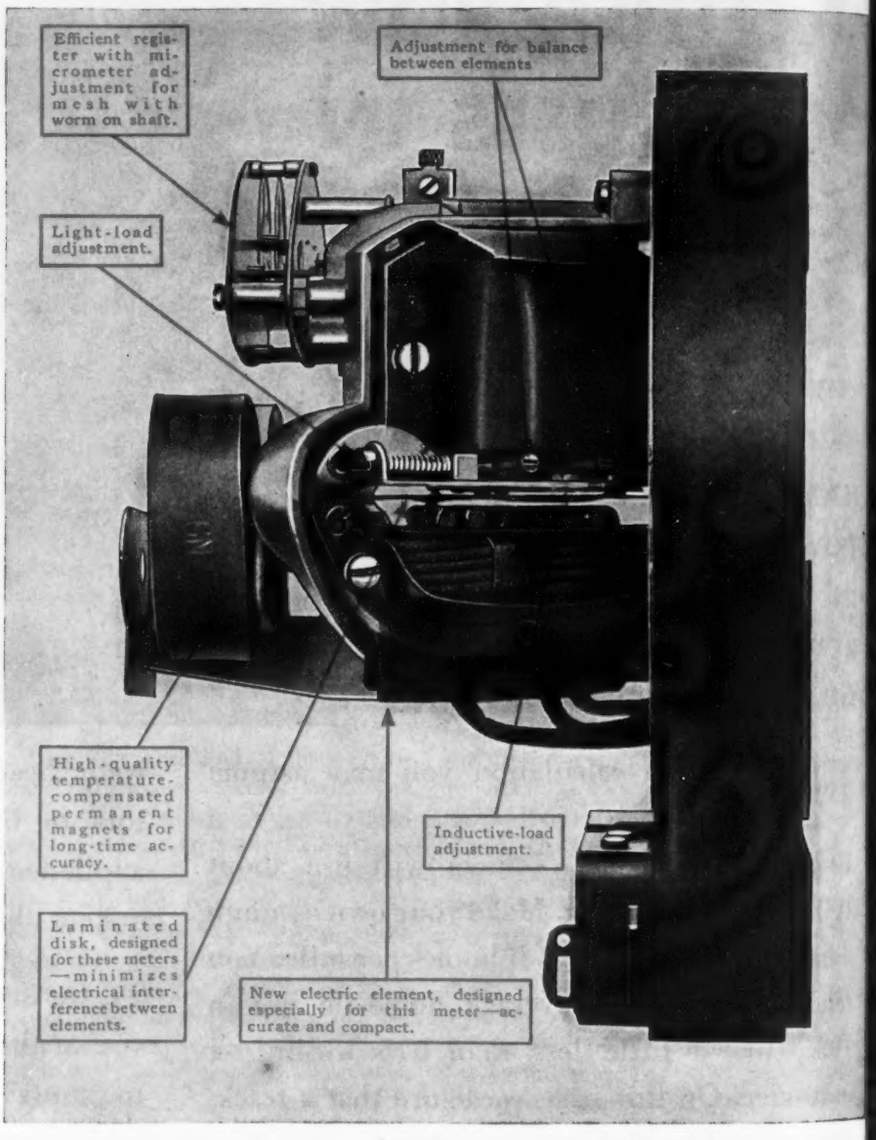
TYPE V-2A FOR WALL MOUNTING

The Type V-2A for wall mounting can be used by itself or with any standard single-phase meter trim, and also with the Type "A" connection box

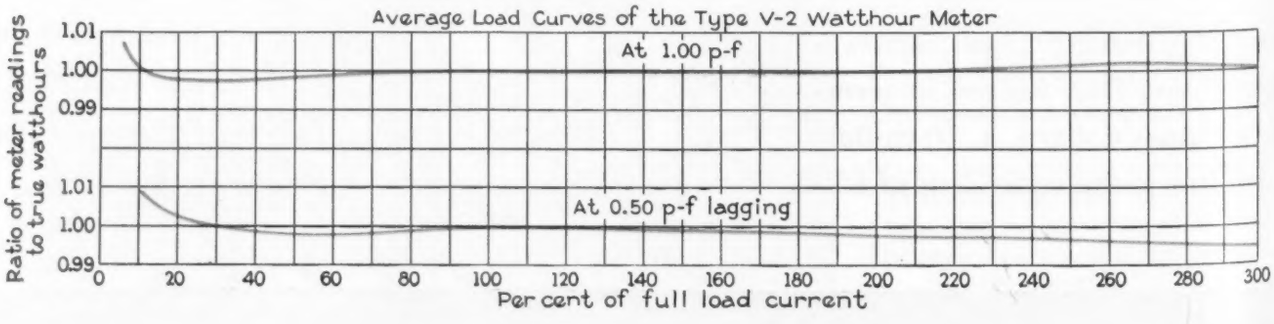
TYPE V-2S FOR SOCKET MOUNTING



Sockets are the same as those for single-phase meters except that they have one extra terminal for potential connection


Efficient register with micrometer adjustment for mesh with worm on shaft.
Adjustment for balance between elements
Light-load adjustment.
High-quality temperature-compensated permanent magnets for long-time accuracy.
Laminated disk, designed for these meters—minimizes electrical interference between elements.
Inductive-load adjustment.
New electric element, designed especially for this meter—accurate and compact.

HIGH ACCURACY AT ALL LOADS

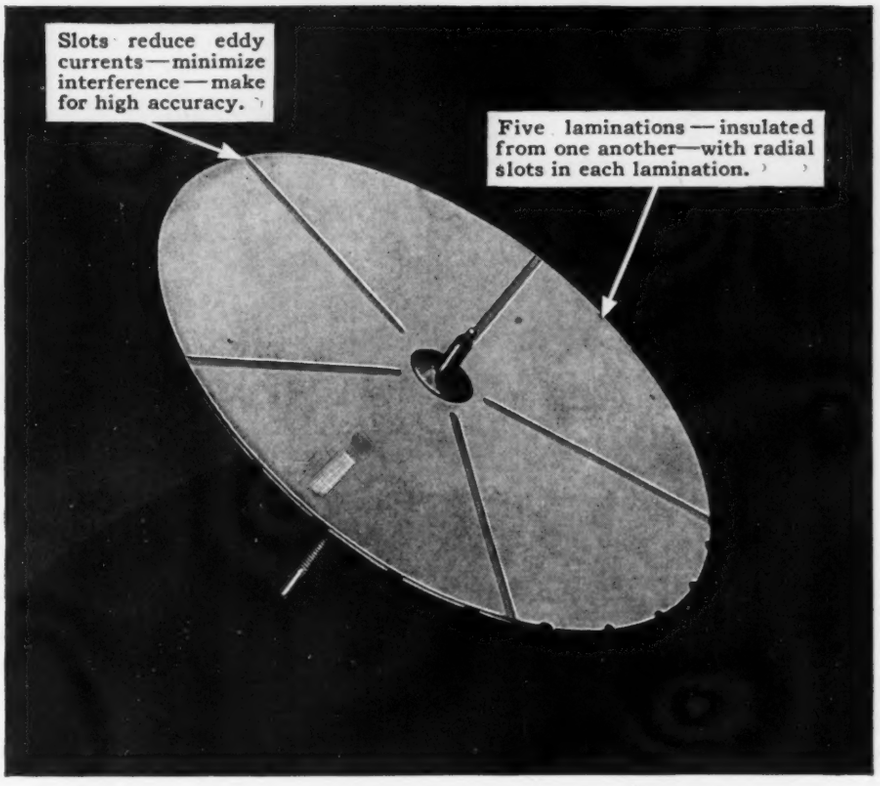


TWO-ELEMENT SINGLE-DISK WATTHOUR METER

WITH A

NEW METERING ELEMENT

A Small, Lightweight, Low-priced Meter for Applications Wherever Two - element Metering Is Desired


Slots reduce eddy currents—minimize interference—make for high accuracy.
Five laminations—insulated from one another—with radial slots in each lamination.

THE NEW General Electric Type V-2A and V-2S watthour meters are designs in which a new electric element and a unique moving element are completely co-ordinated.

Although new in design, the electric elements follow the fundamental principles to which G-E watthour meters owe their superiority. They are compensated for all classes of temperature errors, and are but little affected by wide variation in voltage, power-factor, or frequency.

New design of the moving element has made it possible for both electric elements to act on the disk with negligible interference. Each lamination of the disk has radial slots. In assembly these slots are "staggered," and insulation is inserted between laminations.

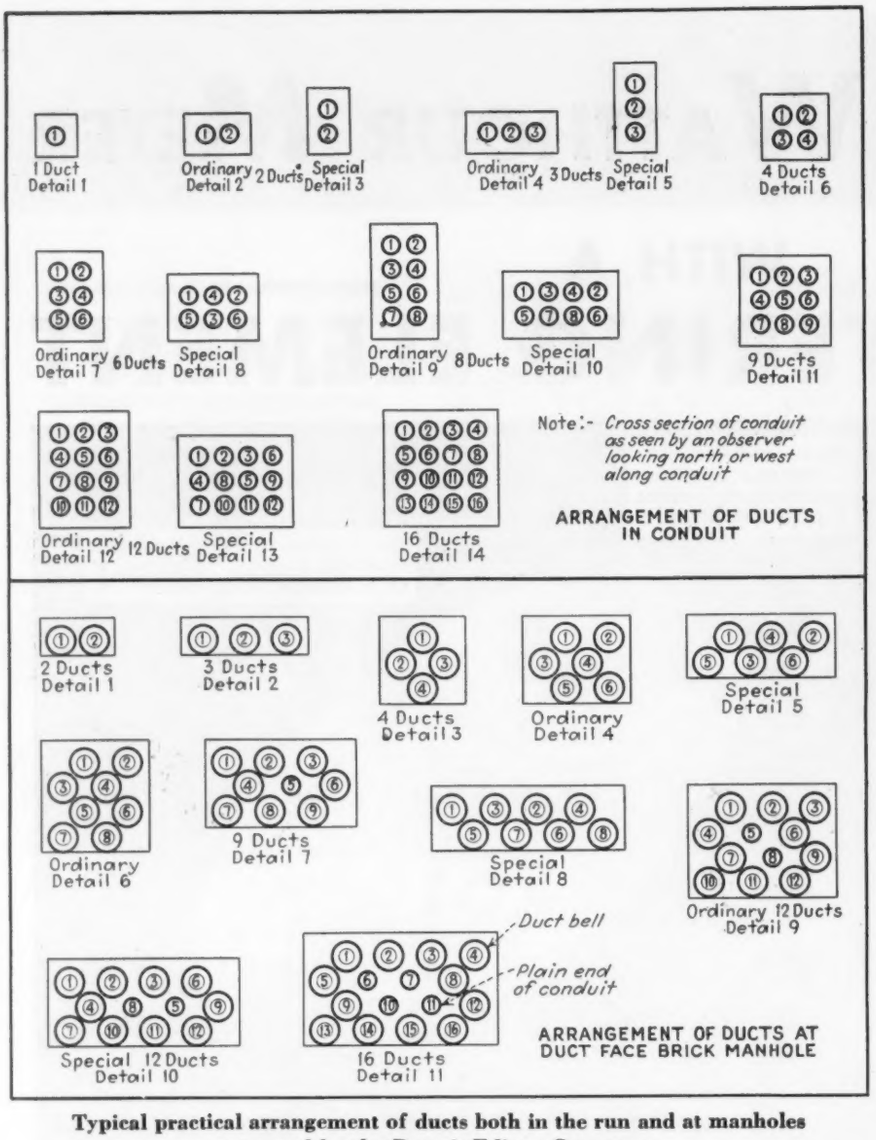
Observe, on the graph, the superior characteristics of this meter. From 10 per cent to 200 per cent it is practically a straight line. Even at 300 per cent the meter is well within accurate metering limits.

This performance insures correct registration under varying conditions. The small size and light weight, combined with similarity to corresponding meters, permit low-cost installation.

Write for a copy of GEA-2404. Address your request to the nearest G-E sales office, or General Electric, Dept. 6A-201, Schenectady, N. Y., and we shall be glad to send you a copy.

400-20

GENERAL ELECTRIC



Typical practical arrangement of ducts both in the run and at manholes as noted by the Detroit Edison Company

This company uses 2-in. fiber for street lighting between lamp posts, 4-in. fiber for all other new work both in main conduit runs and laterals to services, cable poles, etc. Duct bells are used on all outside ducts at manholes. Clay ducts are only used for maintenance where such ducts are already in existence. The ducts are laid generally 30 in. below pavement (surface), 36 in. below dirt surface paralleling pavement, 36 in. below unpaved streets or below sidewalks, 30 in. below driveway or similar private right-of-way, 24 in. below street car tracks (from base of rail), 42 in. below steam or electrified railroad tracks (from base of rail). Centers generally on 8-in. squares for conduit runs, 10½ in. at manhole entrances.

special case. At manhole entrances ducts must be spread out in order to facilitate training the cables.

•

Efficiency of Dust-Catching Systems

Data on the normal efficiency of dust-catching equipment designed for installation in steam-generating plant stack systems were presented before the Massachusetts legislative committee on public health at a recent hearing by F. M. Ives of the Boston Edison Company. The engineering staff provided the figures, which represent the latest information of manufacturers of this class of apparatus:

Stoker-Fired Units		Practical Maximum Load Efficiencies in per cent
Dry	Baffle	65
	Cyclone	70
	Electrostatic with baffle	80
Wet	Impingement pool	70
	Wet surface baffle	75
	Spray scrubber	80
Pulverized Fuel Units		
Dry	Cyclone	50
	Electrostatic	80
Wet	Wet surface baffle	70
	Spray and scrubber	80

Keeping Switchsticks in Good Condition

To maintain wooden "hot line" and switchsticks in good condition, increased attention is being paid to their insulating quality as affected by storage when not in active use. In testing such sticks for hot-line work one company wraps flexible metallic bands around the wood approximately 3 in. apart and applies test voltage between the two bands. These are usually made at three positions along each stick, one test being made at the middle and one at each end. Faults have usually been found more severe at one end, tapering off toward the center of the stick.

When switchstick wood is stored in a dry, heated room very few faults result, according to operating experience. In a typical case where twenty sticks had been out of use and stored in an unheated room for several years practically all the pieces were found to be defective and were recommended for drying. If no insulation tests had been made the wood would simply have been scraped and several coats of varnish applied. The alternating-current resistance on these twenty pieces was from 75 to 500 megohms per 3-in. length. A similar set of good sticks tested well above 2,000 megohms per 3-in. length. These first quality sticks were well varnished and when not in use were hung on a special rack in a heated compartment.

Wooden poles used for operating high-voltage disconnects are tested in representative practice in the same manner as hot-line sticks. At some substations these switch poles are stored in iron pipes with a screw cap at each end to keep out moisture. Some of these pipes are supported on an incline so that water will run out of an opening provided at the lower end. Insulation tests have shown that poles stored in these inclined pipes have higher resistance at the lower than at the upper ends. In one case such pipes were sheltered from the sun by a narrow inclined wooden roof, and the poles thus stored were found in excellent condition. A number of poles were found defective because of contact with concrete floors or damp brick walls. It is expected that more extended testing experience with wooden members of various uses will point the way toward more complete methods of insuring insulation quality over long periods.

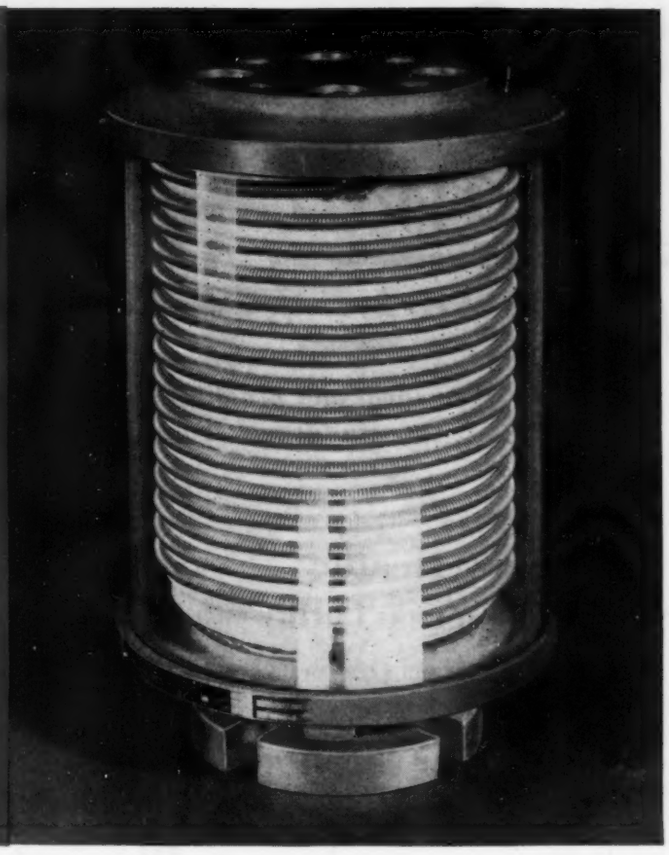
The Only Resistors Completely Visible

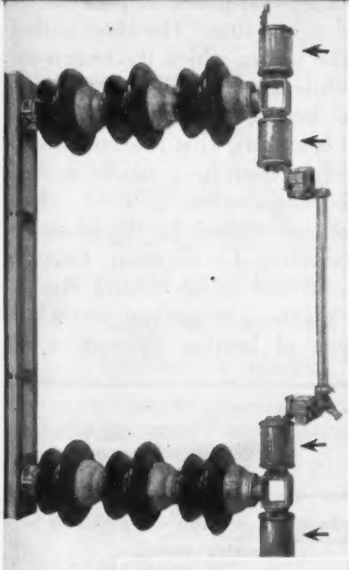
★ ★ ★

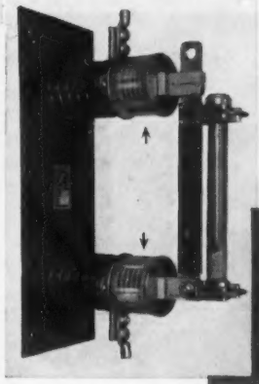
Conditions known at all times—no need to disconnect circuit for inspection

RESISTORS

Protect Costly Connected Equipment







Above: 132 KV—Outdoor S & C Fuse-and-Resistor Combination.

Below: Indoor type S & C Fuse-and-Resistor Combination.

Besides limiting fault currents in case of potential transformer insulation failure and reducing thermal stresses—S & C Resistors and Fuses allow visual inspection. No need to disconnect or dismantle to find out their condition.

These resistor windings are protected against dust accumulation which prevents short circuiting the turns of resistance wire. They are fully protected from the weather. Resistance is so adjusted that accuracy of metering is not affected.

Used in connection with S & C low current type DLC Fuses, the potential transformer is isolated in case of secondary faults as well as primary insulation failures. Maximum in protection for costly connected equipment.

Prevent possible serious damage to *your* equipment with S & C Resistors—easily applied in existing installations.

Note These S & C Advantages

- Visual inspection.
- Sealed against dirt, dust, water—No chance of flashovers between turns of resistor wire.
- Accuracy of metering equipment not affected.
- For use on systems of 2,300 to 138,000 volts.

SCHWEITZER & CONRAD, Inc.,

4435 Ravenswood Avenue — CHICAGO, ILLINOIS

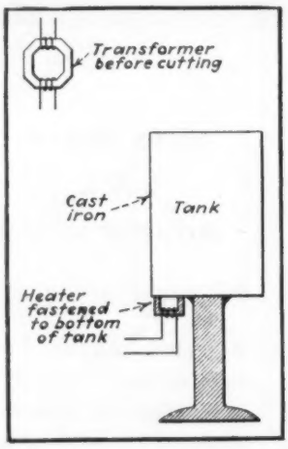
Manufactured in Canada by Powerlite Devices, Ltd., Toronto, Canada

Power AT WORK IN INDUSTRY

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Emergency Heater Serves Process Tank

In casting about for some temporary means for heating a processing tank gradually and uniformly so that production could be started pending permanent installation of commercial heating equipment, a large can manufacturer hit upon a novel scheme for meeting the situation.



Mercury lamp transformer converted to induction heater

Some discarded old-type mercury-vapor lamps had been put in storage. These lamps were designed to operate on 220 volts a.c. and it was found that auto-transformers used with each lamp could be made the basis of an induction heater.

As shown in the sketch, one of the transformers was cut in half between the two windings, which were on opposite sides of the core. After being cut, the poles were carefully squared to fit snugly against the bottom of the cast-iron dope tank. Care in fitting was necessary in order to avoid losses due to reluctance of air. Windings on the core were connected to 110 volts a.c. Results, according to an item in the July, 1936, issue of *Electrical Production* (published by the Electrical League of Cleveland, Ohio), were highly satisfactory.

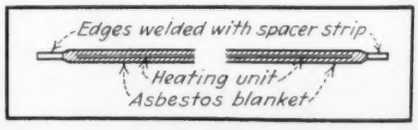
•

Apply Electric Heat to Plywood Press

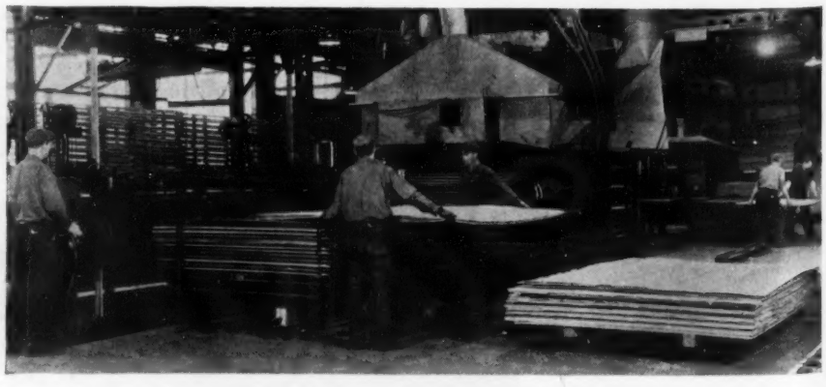
By **GEORGE R. MEYERCORD, Jr.**
Haskelite Manufacturing Corporation, Chicago, Ill.

For perfect bond between the thin sheets of veneer that compose the modern lumber called "plywood" it is necessary that the glue be heat-cured while pressure is applied to hold the sheets tightly together. Usual methods of plywood production employ machines in which the assembled sheets of veneer are compressed between steam-heated platens. These methods have certain deficiencies, due principally to the fact that for best product the heat and the pressure must be applied simultaneously, obviously a difficult achievement when heavy steam-heated platens are used. The platens cannot be cooled off and reheated rapidly for each press operation; they must be kept hot. The veneer sheet assembly thus must be placed in a hot press and if there is any delay in closing the press the glue may be well along toward complete set before the pressure is applied. This is the case particularly in multiple platen presses in which several panels of plywood are pressed at one time. The ideal method would be one in which the heat is applied while the material is in the press and not before.

This is exactly what is accomplished by electric heat in a newly devised plywood production method which has been developed by the Haskelite Manufacturing Corporation, Chicago, and is in use in its Grand Rapids, Mich., plant. The method uses a special type of heating element in the



Schematic section of plywood heater panel



Assembling stacks of heater panels and veneer preparatory to pressing into plywood

To the

THIRD WORLD POWER CONFERENCE

. . . greetings from an organization whose name and winged symbol are well known throughout the power field.

Since 1840 . . . when Henry R. Worthington invented the first direct-acting boiler feed pump . . . Worthington has pioneered and led in the development of many of those classes of equipment which make possible the highly efficient power service the world enjoys today.

Nearly a century of experience and progress . . . a heritage which finds expression in a policy to build only to the highest standards, for enduring performance and economy.

H. B. Bevier

President

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form of a comparatively thin sheet, which because of its small mass can be quickly heated and as quickly cooled in and after each press operation.

In the fabrication of the plywood panels stacks of the veneer assemblies with dry films of synthetic resin glue 0.003 in. thick laid between the sheets are built up with the flat heating units interposed between the panels. The usual stack consists of 23 panels, 6x10 ft., alternately laid with 24 heating units. The assembled stack is rolled into a hydraulic press and the heating units are connected. Then pressure is applied to the whole area of the stack and the current turned on. Included in each load is a group of thermocouples whereby temperatures reached by various parts are indicated to the operator. He so controls the heating current as to meet the specified temperature limits.

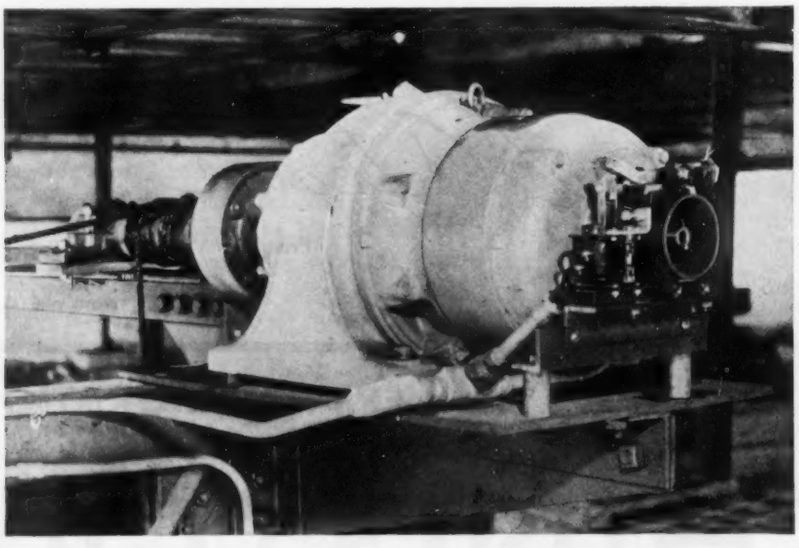
One cycle of operation takes about 30 minutes. The energy-production ratio is about 130 kw.-hr. per 1,000 sq.ft. of panel, or 180 kw.-hr. for each press operation. Since the electrical load is straight resistance, the energy demand is 720 kw., 30 kw. per heating unit.

Because it is impossible to produce veneer sheets of exactly unvarying thickness with the cutting methods used in this class of work it is desirable that there be a certain flexibility in the heating units so that pressure in the stack will be uniformly distributed over the entire area of the panel surfaces. This condition discloses another deficiency of the steam press with the rigid inflexibility of its heater platens. The flexible construction of the electric heating units is shown in the accompanying sketch. The heating element is a simple grid of flat resistance metal strips 0.003 in. thick and about 4 in. wide laid about $\frac{1}{2}$ in. apart and contained between two blankets of asbestos felt with a silicate cement. This core is inclosed in a metal sheathing composed of two thin sheets of steel welded together at the edges.

•

Saving Space in an Elevator Drive

By mounting a 1½-hp. United States "synchrogear" induction motor on an extension bracket at the top of an elevator frame the Boston Envelope Company, Dedham, Mass., saved about one-third the space required by an ordinary motor drive with independent gear reduction. One coupling and two bearings are eliminated. The motor with integral gears in an oil housing and attached electromagnetic brake are but 24¾ in. long over all. Speed reduction from motor shaft to the elevator windlass shaft is from 1,800 to 14.4 revolutions per minute. Capacity of the elevator is 3,000 lb. It has a 7x8-ft. platform with a travel of 5 ft. Speed is 13½ ft. per minute and there are two winding drums on the main shaft, to which the platform is attached by a ⅜-in. rope cable. The elevator is used in handling raw stock deliveries and finished product shipments between the shipping room and the floors of road trucks at the plant doorway.



Self-contained motor and reduction gear housing with overhanging brake for quick stopping make compact elevator drive

Stop No-Load Losses to Reduce Power Cost

By J. L. YOUNG
Industrial Vocational Instructor,
St. Mary's, Ohio

Elimination of the no-load and copper losses of a 600-kva. power transformer bank at the Tool Steel Gear & Pinion Company plant, Cincinnati, Ohio, by cutting off all current flowing through the power bank during holidays and for periods of 42 hours each week-end permitted this company to realize considerable annual saving in charges for energy consumed in the core and coils of the power bank. Power is metered on the high-voltage side of all transformers and oil switches Plant and cost analysis data indicated in the accompanying table showed the annual cost or core and copper losses in the transformer banks to be $284.71. Hourly loss during winter months is 0.5 kw. higher than for summer months because of the increased copper loss with operation of motors in the heating plant. By replacing the 220-volt, three-phase motors driving boiler feed pumps in the heating plant with 220-volt, single-phase repulsion induction motors fed from a small lighting transformer operating independent of the power bank further need for the three-phase power in the plant on week-ends and holidays was eliminated. After closing the plant each week, therefore, the main 13,000-volt oil switch on the primary side of the transformer was opened, hence stopping all core and copper losses in the power transformer banks.

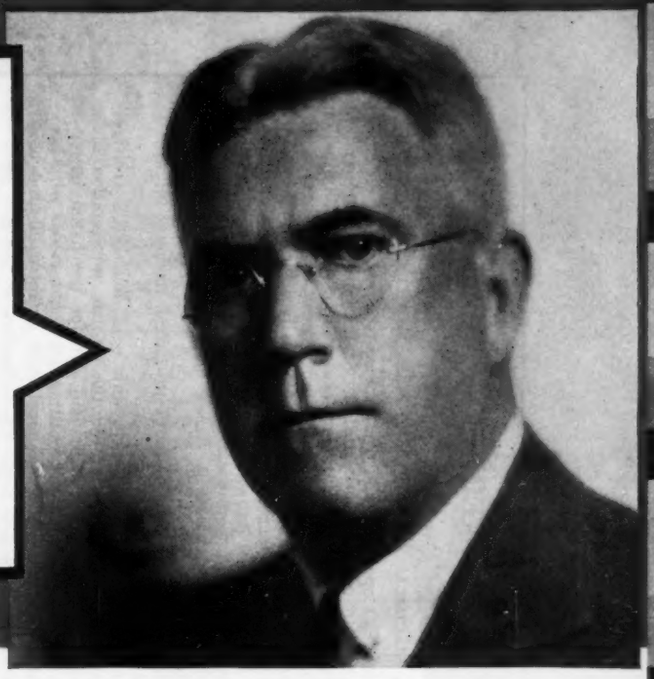
Cost of the entire change-over, including motors, supplies and labor, amounted to $136. Since this plan of operation has been carried out the savings have paid for the installation several times with considerable return on the investment.

Seasonal Transformer No-Load Losses

	Summer	Winter
Loss per hour, kw.	6	6.5
Number of hours (26 week-ends)	1,092	1,092
Kilowatt-hours	6,552	7,098
Cost per kw.-hr.	$0.0175	$0.0175
Loss during six months	$114.66	$124.12
Total yearly loss (includes $45.93 for holidays)		$284.71

"ANNUAL AVERAGE REVENUE IS ABOUT $30 PER WATER HEATER"

With No Increase In Capital Investment



—FRANK McLAUGHLIN, *President,*
Puget Sound Power & Light Co.

THE importance of the modern electric water heater as a profitable load-building factor in successful utility operation has been tested and proved by hundreds of utility companies throughout the country. Read what Frank McLaughlin, president, Puget Sound Power & Light Co., says about this modern appliance!

"OUR system load is about 200,000 kilowatts, and about 30,000 kilowatts can be devoted to water heating on a 20-hour basis, without creating a new peak. Indications are that our water heater load has a diversity of about 2 to 1; that is, a 2500 watt, 40 gallon heater imposes a load on the power plants of about 1250 watts; 30,000 kilowatts of capacity would therefore take care of about 24,000 water heaters.

"Our rate for metered off-peak water heating is 7½ mills per kilowatt hour and at this rate *the average annual revenue is about $30.00 per heater.*

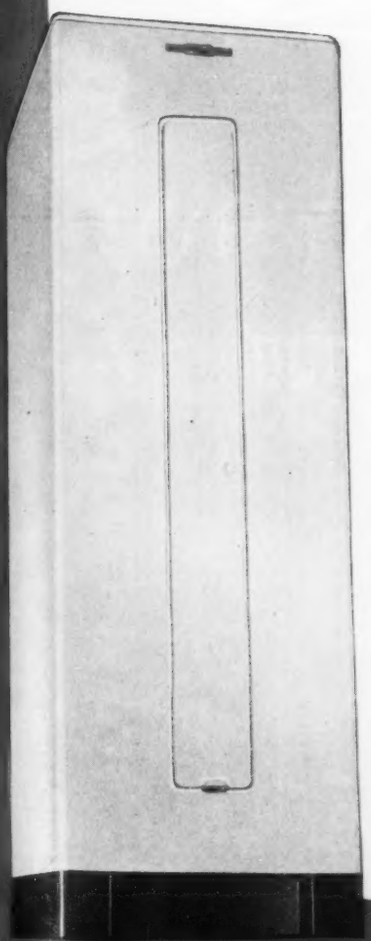
"The net revenue after all incremental costs, including fixed charges, will of course vary, depending on the extent to which deficiencies in hydro kilowatt hours have to be made up with steam, but we believe it is safe to say that the net should average at least 50% of the gross. The off-peak water heater is therefore a decided asset to the rate payer as a 'rate reducer,' as well as an asset to the individual enjoying real water heating service, and to the company and its investors.

"The off-peak water heater load of course matches up beautifully with range load and the two taken together have an excellent load factor and produce a reasonable rate per kilowatt for the peak loads produced.

"We are this year devoting more energy to the sale of water heaters than to ranges or refrigerators and our present program is to continue this policy."

Scores of other companies, too, are turning to the electric water heater for profitable load-building.

Hotpoint is ready to help you enjoy this profitable load with the most complete line of electric water heaters at the lowest prices in history. Whether your system requirements are for off-peak or continuous service, Hotpoint has the model and type of electric water heater to meet your needs.



5 REASONS for HOTPOINT LEADERSHIP

Large scale manufacturing—Reduced prices—Foremost design—Vast improvements—Calrod, Hotpoint's sealed electric unit, immersed within the tank. Delivers all the heat generated directly to the water.

●

For Fall, Hotpoint also offers you a complete sales program—The Election Campaign—including newspaper advertisements, direct-mail, outdoor posters, window display material and sales contest. Ask the Hotpoint representative how you can put it to work for you now—PROFITABLY!

THE VOGUE—*Hotpoint's new, modern style square-type water heater, gives hot water every hour of the day or night without one minute's attention from anyone.*

EDISON GENERAL ELECTRIC APPLIANCE CO., Inc.
5618 West Taylor Street, Chicago, Illinois

AUTOMATIC **Hotpoint** ELECTRIC
WATER HEATERS

ELECTRIFIED BREWERIES (Continued) (7)

Economical Operation

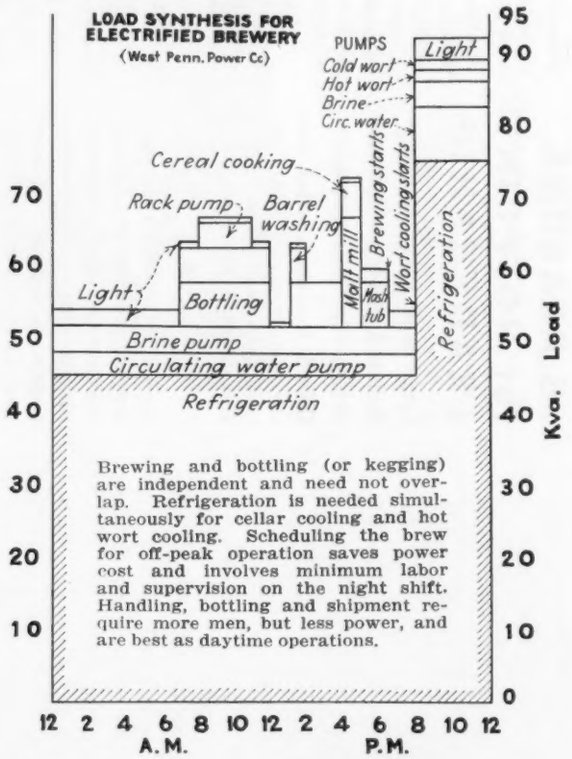
Revival of brewery operations has been accompanied by an altered conception of the relative merits of purchased power vs. a brewery power plant. Some modern breweries are purchasing all their power requirements; many buy 15 to 75% of their power requirements. Schedules of existing breweries can be so arranged as to loads of motor-driven equipment and compressors (and of motor-generator sets where d.c. is used) that at least 60% of the power can advantageously be purchased.

Refrigeration—Study of the operating cycle of pre-prohibition steam-driven refrigerating machinery for breweries reveals that:

1. The peaks of heating and refrigeration are not concurrent.
2. High-pressure steam is required 24 hours a day, thus (a) requiring licensed engineers for three shifts, (b) increasing boiler maintenance costs, (c) shortening life of boiler house equipment.
3. Use of a single refrigerating compressor large enough to handle the peak loads leads to inefficient operation throughout off-peak periods.
4. Failure of a single large unit or boiler means loss of the entire brew.

Electrically driven equipment is admirably adapted. One unit should be large enough to care for all cellar cooling and air conditioning; the other for wort cooling, but in no case so small that it cannot be used as standby while first is in overhaul. These provide:

1. Reduction of steam pressure to approximately 15-30 lb.
2. Replacement of 3 or 4 licensed engineers.
3. Banking of boilers except for short periods when cooking and brewing is done.
4. Decreased boiler maintenance.
5. Long postponement of boiler replacement.
6. Increased efficiency through use of two units.
7. Removal of danger of contaminating steam by oil, etc.
8. Ease of operation.
9. Ability to better maintain refrigerating equipment and thus eliminate danger of break-down during peak requirements.
10. Cleanliness.
11. Highest efficiency and lowest cost.



ELECTRIFIED BREWERIES (Continued) (8)

Economy of Purchased Power

(See Gilbert Wilkes, ELECTRICAL WORLD, Feb. 2, 1935; May 11, 1935)

Breweries not handicapped by high operating and overhead costs of steam-driven equipment have been found better able to compete successfully. Savings are to be found in (1) elimination of steam wastage by stopping all reciprocating engines, (2) elimination of pipe loss whenever steam is not required, (3) by reducing number of firemen and mechanics, (4) by lower maintenance and overhead costs of electrically driven machines.

That the exhaust steam can be used for heat is rarely true; ordinarily, the only application for oily exhaust steam is in the hot brewing-water tank. The heaviest demands for power occur during the 2 or 3 hours of wort cooling which occur 8 or 10 hours after the hot water has to be used. Recuperation is a remote possibility. Little steam is required for the bottle washer bath heating.

Live steam is generally injected directly in the baths of barrel washers, filter-masse washers, bottle washers and pasteurizers.

Fifty men staffed one plant that brewed continuously with a 125-bbl. kettle (refrigeration, 35-ton electric and 65-ton Corliss). Tests proved the electric refrigeration alone sufficient. In contrast, a small modern 100-bbl. plant laid out for purchased power is operated by only three men except when packing and bottling are simultaneous with brewing. Steam for brewing is obtained from a 100-hp. automatically operated oil-fired boiler.

Monthly Steam and Kw.-Hr. Usage Before and After Electrification of 100-Bbl. Brewery

	Before	After		Before	After
Beer brewed (bbl.)	6,104	6,461	Power purchased (kw.-hr.)	3,040	70,325
Coal consumed (lb.)	616,000	251,500	Power factor (per cent)	49	99
Steam generated (lb.)	4,350,000	1,656,000	Demand (kw.)	29	165

Distribution of Costs

Electric Service

	Consumption (Kw.-Hr.) Before	After
Purchased Power		
Bottling plant	2,100	3,000
Ammonia compressor	0	30,925
Motor-generator set	0	19,200
Brew house and pumps	300	3,500
General lighting	640	3,000
Air compressor	0	10,700
Total	3,040	70,325
D.C. Generation		
Water pump	6,000	0
CO_2 compressor	1,500	0
Misc. brewery pumps	1,000	0
General lighting	660	0
Total	9,160	0
A.C. Air Compressor		
Refrigeration	0	3,700
Brewing	0	3,300
Wash house	0	3,700
Total	0	10,700
Motor-Generator Set		
Water set	0	10,000
CO_2 compressor	0	3,000
Misc. pumps	0	6,200
Total	0	19,200

Steam Service

	Consumption (Lb. of Steam) Before	After
Steam Utilization		
D.c. generation	916,000	0
Air compressor		
(To refrigeration)	700,000	0
(To wash house)	260,000	0
Refrigeration	1,208,000	0
Brewery	305,000	356,000
Wash house	130,000	450,000
Bottling plant	360,000	450,000
Building heat	471,000	400,000
Total	4,350,000	1,656,000
City Water	Cu.Ft.	Cu.Ft.
Brewery	120,000	151,000
Wash house	133,365	.....
Boiler feed make-up	70,000	27,000
Total	323,365	178,000

After electrification, the use of steam for power purposes was cut out entirely. Refrigeration was secured from one 65-ton compressor. The d.c. load was carried on motor-generator set. Air for water pumping and other uses was obtained from a single-stage electrically operated air compressor.

Modernize with DIEHL MOTORS

TYPICAL APPLICATIONS

ADDING MACHINE
AIR CONDITIONING MACHINERY
AGITATORS
BAKERS' MACHINERY
BALANCING MACHINES
BATTERY CHARGING SETS
BLOWERS
BOOKBINDERS' MACHINERY
BOTTLING MACHINERY
BOX MAKING MACHINERY
BRICK MAKING MACHINERY
CALCULATING MACHINES
CAMERAS & PROJECTING EQUIP'T
CANDY MAKING MACHINES
CANNING MACHINERY
CEMENT MAKING MACHINERY
CHEMICAL PLANT MACHINERY
CHURNS
CIGARETTE MAKING MACHINES
CIRCULATORS, AIR
CLAY MAKING MACHINES
CLEANERS, HAT
COAL MACHINERY
COKE MACHINERY
COFFEE MACHINERY
COMPRESSORS
CONVEYORS
COUPON CUTTERS
CRANES
DAIRY APPARATUS
DENTAL MACHINES
DISHWASHERS
DRIERS
ELECTRO-PLATING EQUIPMENT
ELEVATORS
EMBOSSING MACHINES
ESCALATORS
FANS, EXHAUST
FERTILIZER MACHINERY
FILLING MACHINES
FILTERS
FIRE ALARM SYSTEMS
FLOUR MILL MACHINERY
FOOD PROCESSING MACHINERY
GENERATING EQUIPMENT
GLASS MAKING MACHINERY
GRINDING MACHINERY
HAT MAKING MACHINERY
HOISTS
HUMIDIFIERS
HYDRAULIC MACHINERY
LAUNDRY MACHINERY
LEATHER MAKING MACHINERY
LOOMS, TEXTILE
MACHINE TOOLS
- DRILL PRESSES
- PUNCH PRESSES
- SHAPERS
- GRINDERS
- BORING MILLS
- PLANERS
- LATHES
- SHEARS
- BLANKING PRESSES
- ETC.

MARINE MACHINERY
METAL WORKING MACHINERY
MINING MACHINERY
MIXERS
MOTOR-GENERATOR SETS
OFFICE APPLIANCES
OIL BURNERS
OVENS
PAINT MAKING MACHINERY
PAPER MAKING MACHINERY
PETROLEWM PRODUCTS MACH'Y
PHONOGRAPHS
POLISHING MACHINERY
POWER PLANT MACHINERY
POWER TABLES
PRINTING MACHINERY
PULVERIZERS
PUMPS
RECORD CHANGERS
RECORDING INSTRUMENTS
REFRIGERATING MACHINERY
RUBBER MAKING MACHINERY
SCALES
SEPARATORS
SEWING MACHINES
SHOE MAKING MACHINERY
SMELT'G & REFIN'G MACH'Y
SOAP MAKING MACHINERY
STOKERS, MECHANICAL
STONE WORKING MACHINERY
SUGAR REFINING MACHINERY
TABULATING MACHINES
TESTING MACHINES
TEXTILE MACHINERY
TYPEWRITERS
UNIT HEATERS
VACUUM CLEANERS
VENTILATING EQUIPMENT
WASHING MACHINERY
WEIGHING MACHINERY
WINCHES
WOODWORKING MACHINERY
WRAPPING MACHINES

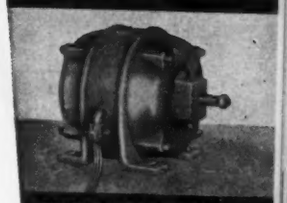
CHEMICAL PLANT M

CRANE AND HOIST MOT

DIRECT CURRENT MOTORS TYPE K

SLIP RING MOTORS

FLANGE TYPE MOTORS

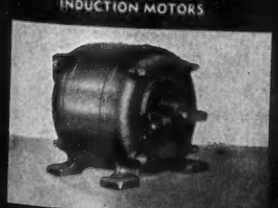

TEXTILE LOOM MOTORS

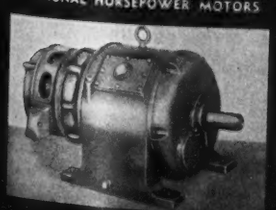
D. C. UNIVERSAL MOTORS

TICAL TYPE MOTORS

Benefit by our Experience

REPULSION START INDUCTION MOTORS


SPLIT PHASE FRACTIONAL HORSEPOWER MOTORS

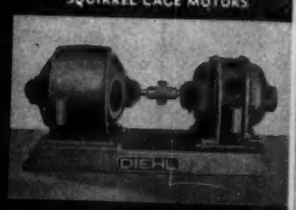

GEAR MOTORS

THE same facilities and abilities which have enabled Diehl to design and produce motors that meet all Singer Sewing Machine requirements and those of many equally exacting manufacturers in other fields, are available also to you. The broad line of standard Diehl motors makes it possible to offer a motor exactly suited to practically any specific requirement—and special designs are obtainable for meeting exceptional conditions. Diehl motors embody the newest approved engineering advances and sustain the quality standards which Diehl products have maintained for half a century.

The "Diehl Simplified Price List and Catalog" is proving extremely helpful to all who choose and use motors. Write for your copy.

TOTALLY-ENCLOSED FAN COOLED SQUIRREL CAGE MOTORS

GENERAL PURPOSE SQUIRREL CAGE MOTORS



MOTOR GENERATOR SETS

DIEHL MANUFACTURING CO., Elizabethport, N. J.

Pioneer Manufacturers of Motors, Generators and Fans

Electrical Division of THE SINGER MANUFACTURING CO.

ATLANTA BOSTON CHICAGO DALLAS NEW YORK PHILADELPHIA

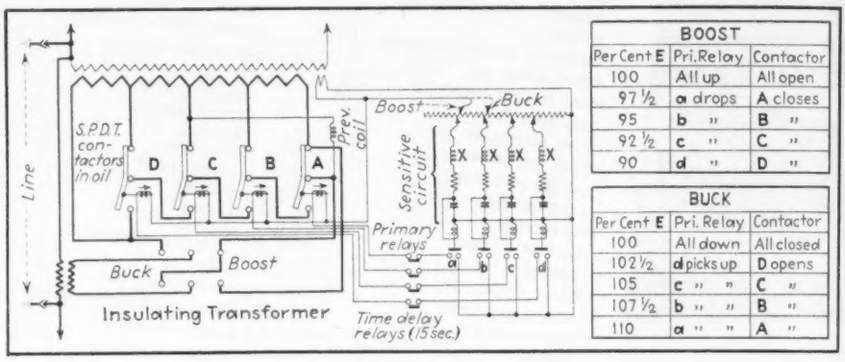
New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Support Heavy Cable with Pull Box

Cables carrying power from the power house on the floor of the canyon at Boulder Dam to the hoist house on the canyon rim must pass through a tunnel in the canyon wall, which is about 1,150 ft. long and inclined at 40 deg. with the horizontal. Problems of supporting power cables in this tunnel were solved by using heavy bronze cable grips in pull boxes every 96 ft. These grips are fastened to the upper ends of the pull boxes with eyebolts and turnbuckles in the manner shown in the accompanying chart.

Of all the cables in the tunnel the largest is a three-conductor, 500,000-circ.mil, 5,000-volt, varnished-cambric-insulated, lead-covered cable for the hoist house and permanent cableway power supply. It has an outside diameter of 2.6 in., weighs 11.04 lb. per linear foot and is about 1,500 ft. long. Pull of this cable down the incline amounts to approximately 7,700 lb. Friction reduces this pull somewhat, but the grips are amply strong enough to carry the entire downward pull of the cable, disregarding any friction, it is declared by engineers of the U. S. Department of the Interior, Bureau of Reclamation.



BOOST		
Per Cent E	Pri. Relay	Contactor
100	All up	All open
97½	a drops	A closes
95	b "	B "
92½	c "	C "
90	d "	D "

BUCK		
Per Cent E	Pri. Relay	Contactor
100	All down	All closed
102½	d picks up	D opens
105	c " "	C "
107½	b " "	B "
110	a " "	A "

New automatic step type regulator

Tap Changing by Resonant Circuit

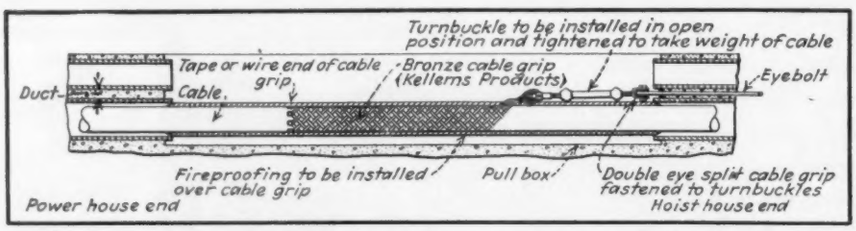
By W. F. GAKLE
Chief Engineer Kuhlman Electric Company, Bay City, Mich.

When an inductive circuit approaches magnetic saturation there is a more or less sharp knee in the curve of voltage against current. By proper design and proportion of such a circuit the knee can be made very abrupt so that at the critical point a small change in voltage will cause a large change in current. This phenomenon is put to work in a new type of transformer designed for rural service and with which is combined a regulator for automatic tap changing under load.

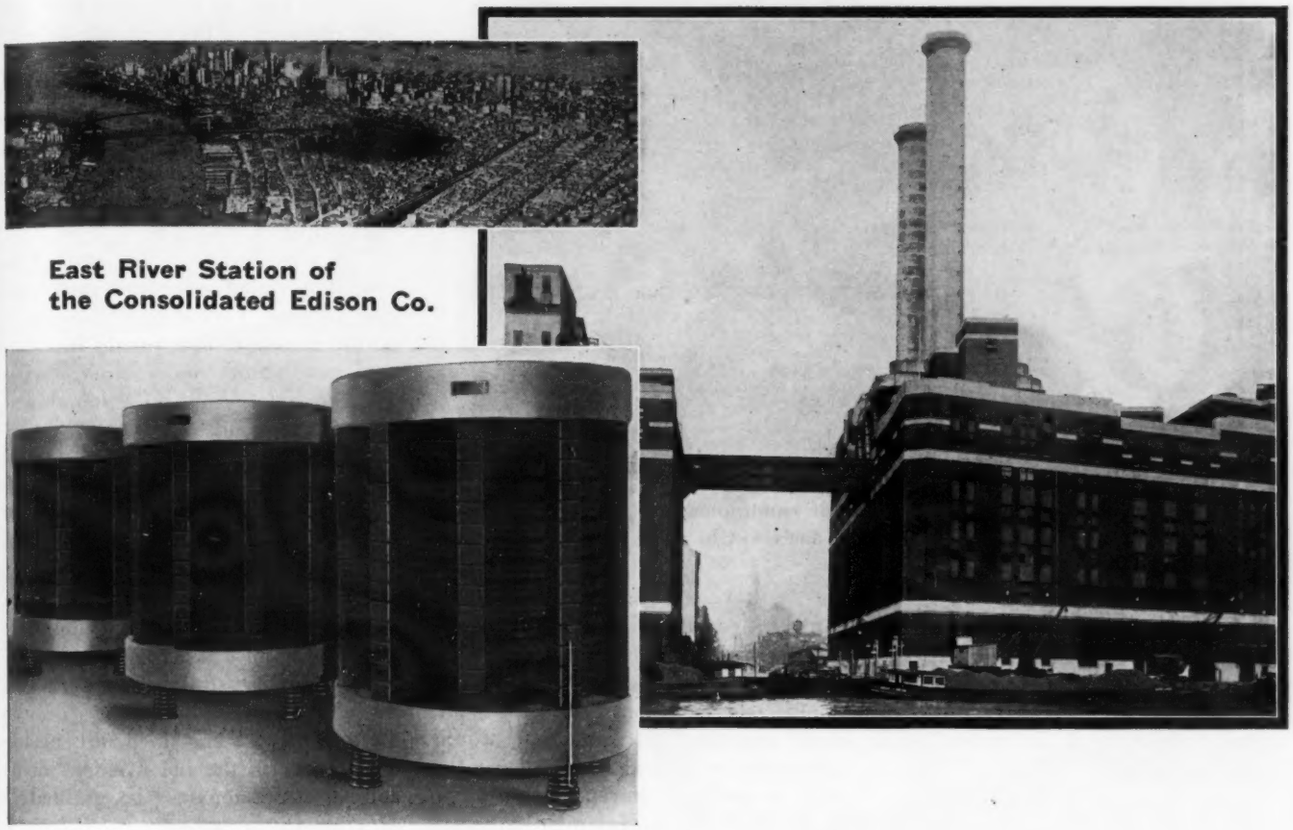
The circuit scheme of such a device with four steps in both buck and boost is shown in the accompanying drawing. This diagram shows a regulator only with its effect applied to the line through an insulating transformer. However, it is apparent that the scheme can be built into a transformer very readily. Energy for the control circuit is supplied from a small auxiliary winding on the regulator core. The four inductances (X) are so proportioned in relation to their places in the sensitive circuit that as the voltage changes they close or open their associated relays in the operating order shown.

The circuit requires manual change between buck-and-boost operation to reverse the connections of the insulating transformer and to change the characteristics of the sensitive network. In the boost position the primary relays are all open at normal line voltage; that is, with no boost applied. In the buck position these relays are all closed at normal line voltage. This difference is accomplished by moving the hot tap on the voltage divider resistor to a lower point, as indicated in the diagram.

Although the term "resonant" is ap-


Turnbuckle to be installed in open position and tightened to take weight of cable
Tape or wire end of cable
Bronze cable grip (Kellems Products)
Eyebolt
Duct
Cable
grip
Fireproofing to be installed over cable grip
Pull box
Double eye split cable grip fastened to turnbuckles
Power house end
Hoist house end

Bronze mesh-type cable grips in pull boxes support heavy Boulder Dam cables in long inclined run



East River Station of
the Consolidated Edison Co.

FOR THE MOST POSITIVE KIND OF PROTECTION AGAINST SHORT CIRCUIT DAMAGE

SOME TYPICAL USERS

Northwestern Electric Co.
Southern California Edison Co.
Commonwealth Edison Co.
City of Seattle
Detroit Edison Co.
Tennessee Elec. Power Co.
Edison Electric Illuminating Co. of Boston
Virginia Electric & Power Co.
Kansas City Power & Light Co.
Columbus Railway, Power & Light Co.
Northern States Power Co.
City of Tacoma
Syracuse Lighting Co.
Philadelphia Electric Co.

In Manhattan, as in many other Metropolitan areas, Murray Low Loss Reactors are protecting important primary distribution systems.

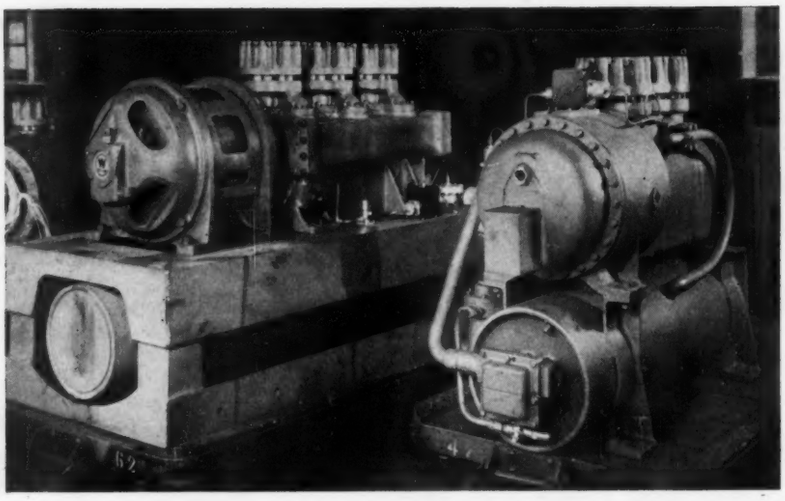
For over 25 years these current limiting reactors have been favorably known as providing a maximum in short circuit protection.

Murray Reactors are supplied for all kinds of services. Dry type reactors for line voltages up to 33 K.V. for indoor or outdoor installation—as large as 5,000 amperes—as small as .4 K.V.A.

Our engineers welcome consultation. Write for interesting 32-page booklet.

METROPOLITAN DEVICE CORPORATION
Brooklyn, New York

MURRAY CURRENT LIMITING REACTORS



Bold departure advances air conditioner design

New Westinghouse unit much lighter, small and easier in power requirements because of housing motor with crankcase.

plied to this circuit, such use is not quite correct. The circuit is not to be considered resonant in the exact meaning of being critical as regards frequency; instead, it is critical with respect to voltage.

•

Conditioner Designed for Smaller Space

By radical departure in design Westinghouse air-conditioning engineers have halved the weight of last year's compressor-condenser, reduced the six cylinders to four without loss in output and eliminated the bedplate entirely. These gains carried with them the virtue of hermetic sealing and of reduced motor size.

As shown by the illustration (units are of equal capacity) the condenser shell and its feet become the base for the motor-compressor, which has 3-point support to simplify machinery and alignment. But most prominent is the adoption of the domestic refrigerator practice of housing the motor with the crankcase, thus eliminating any outbearing and the leaks that call for so much stuffing box servicing. Further, the waterjacket cooling of the compressor embraces the motor shell, thus removing all heat that would otherwise militate against locating the unit in confined, unventilated spaces. E. R. Wolfert the designing engineer, states that the motor cooling raises the temperature of the cooling water only about 1 deg. F. beyond what it becomes in cooling the cylinders and oil.

Section and discharge pipes are the only external piping required, thus reducing leaks from vibrating pipe causes.

Comparative Data

	6-Cyl. Model of 1935	4-Cyl. Hermetic Seal (1936)
Weight (lb.)	3,300	1,600
Dimension (inches)	77 x 31 x 43	54 x 26 x 40
Speed (r.p.m.)	870	1,160
B.t.u. per hour	165,000	156,000
Rated motor (h.p.)	20	15
Relative gasket surface	100	50

•

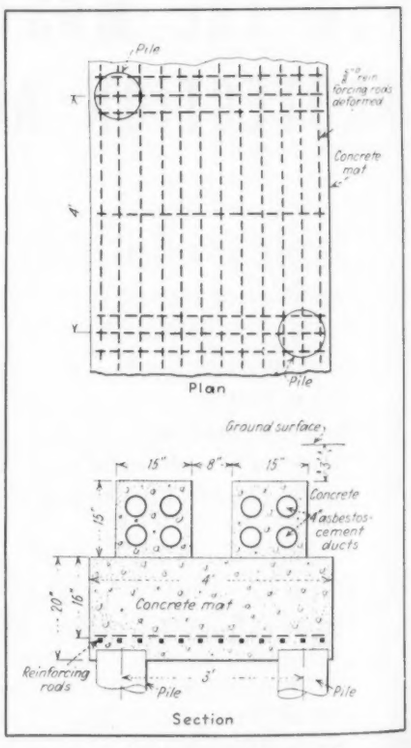
Cement Duct Has Pile Foundation

A 400-ft. section of eight 4-in. pressed asbestos-cement ducts, recently completed in the Port Morris freight yards at Bronx, N. Y., has a wooden pile foundation. Two rows of piles, 3 ft. apart and staggered, were driven in the bottom of the duct trench through 35 ft. of cinder fill, 15-20 ft. of wet plastic clay and 8-10 ft. into the firm soil beneath the clay. Each pile will carry a safe load of at least 8 tons; several will carry much more. A reinforced concrete cap, 20 in. thick and 4 ft. wide, was poured on top of the piles as shown in the figure. The longitudinal reinforcing bars were made continuous by splicing.

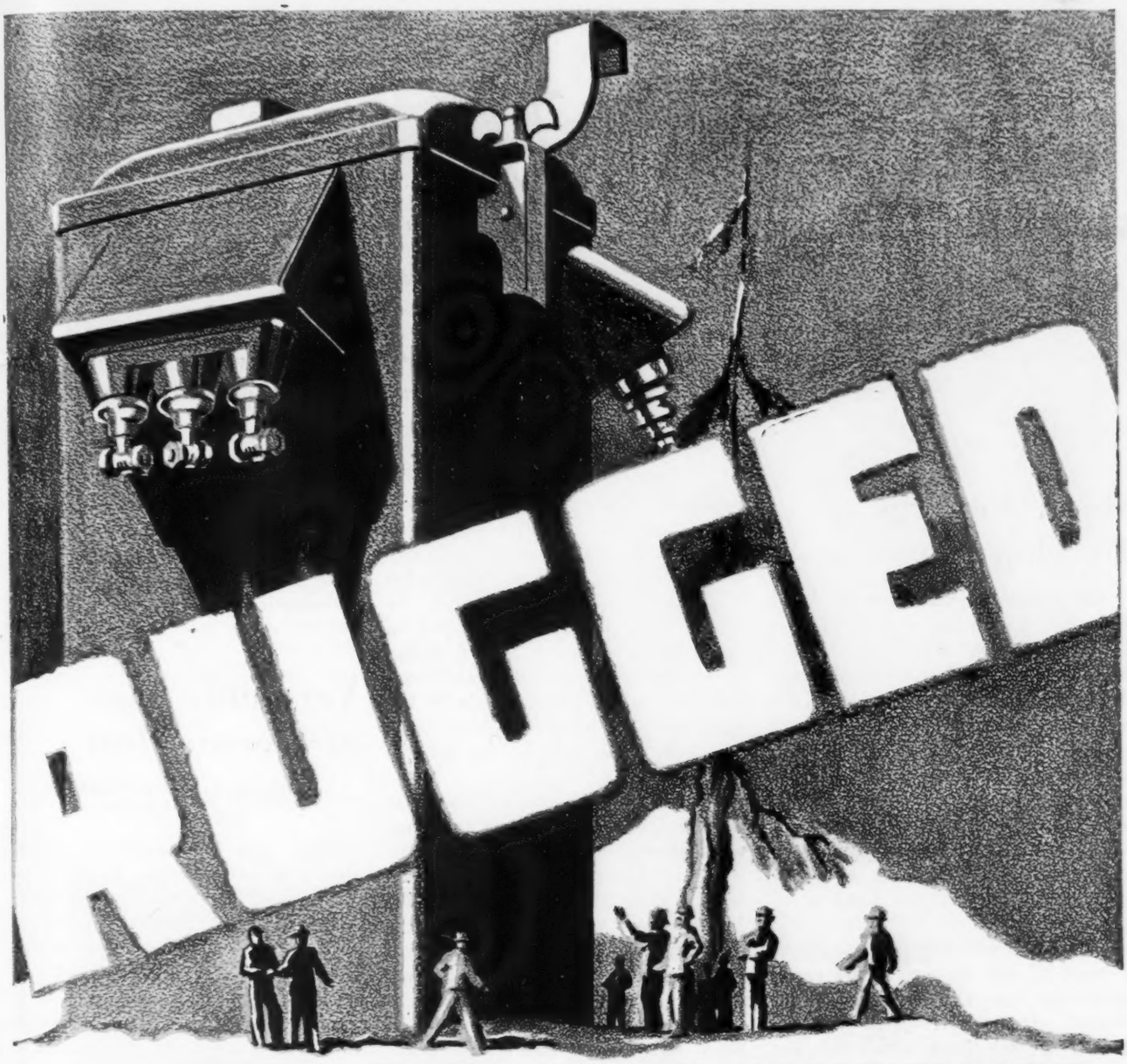
The ducts are in two banks of four, each two ducts wide and two high. They are covered with 3 ft. of cinder fill. One bank of four ducts goes into each chamber of the twin manholes in this section, which is part of a half-mile run built to carry high-tension cables between Hell Gate and Port Morris generating stations. All the other sections of the run are of ordinary construction—fiber in concrete on earth subgrade.

This was the first installation of the new thin-walled asbestos-cement conduit in New York City following its public announcement, made less than a month before construction started. The combination of pile foundation, heavy cap and corrosion-resistant, fireproof conduit was called for by the severe conditions imposed by the corrosive cinder fill, unstable subgrade, salt ground water, the heavy, and sometimes vibrating, loads expected to pass over the duct line on the several score of existing and proposed railroad tracks above it and the relative inaccessibility of the duct line for purpose of repair. Besides the many tracks and third rails on top of it, there is the inconvenient delay before permission can be granted to excavate in the area.

This construction, easily able to withstand several times the physical and chemical stresses ever likely to be imposed upon it, may be the finest duct bank that has ever been put into the ground.



Ducts laid in concrete envelopes on top of the cap



DISTRIBUTION TRANSFORMERS

L-M Transformers are built to "take it". Heavy insulation plus coordinated stud type bushings guard against lightning. Sturdy coils stand up under short circuit stresses. Rectangular core type construction decreases burnout danger. Every part, from core to sheet steel tank, is rugged . . . built for long life and low maintenance. See the cutaway L-M Transformer next time your L-M salesman calls. . . . Write for Catalog T-2.

LINE MATERIAL CO.

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

Building Up THE LOAD

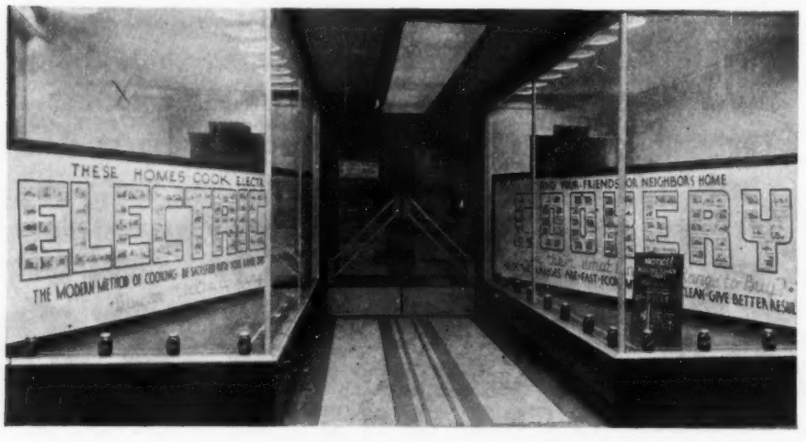
New ideas and practices in selling electrical equipment and service to industrial, commercial and domestic customers

Home Pictures Develop Prospects

Electric range sales are promoted by a novel plan recently adopted in Leavenworth and Easton by Kansas Electric Power Company under the direction of F. M. Kimball. Mr. Kimball's procedure was to take a picture of every home in Leavenworth which was using an electric range. These pictures were posted on panels in the windows of the utility company's salesrooms. Simultaneously with the posting of the pictures an advertisement was placed in the local newspapers announcing a free prize award of salt and pepper shakers along with a copy of the picture to all range users who were able to identify their homes. The advertisement was repeated several times within a short time after its first appearance.

When the prize claimants appeared they were asked to sign a statement setting forth what features they liked best about their electric range and what friends of theirs would be interested in electric cooking. Thus a list of good prospects was compiled. In addition the pictures were posted on small sheets to fit a looseleaf binder, along with pertinent selling information and the statements made by the customer for a localized sales manual which is to be used by the kitchen specialist.

Mr. Kimballs' scheme of promotion was highly successful. Within one week more than one-half of the range users in Leavenworth had crowded into the store to claim their premiums. Many others were attracted by the display to try to recognize their neighbors' houses. An opportunity was created to talk trade with the old users and to consult with other interested individuals. In Leavenworth the Kansas Electric Power Company averaged about 1½ prospects per user. In nearby Easton the plan was equally successful. As yet the sales force has not been able to follow up properly all prospects, but the results of the plan so far seem to more than justify its adoption.



Is your home pictured here, company asks

Electric range users in Leavenworth and Easton received salt and pepper shakers in Kansas Electric Power Company contest

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Versatility Asset of Electric Heat

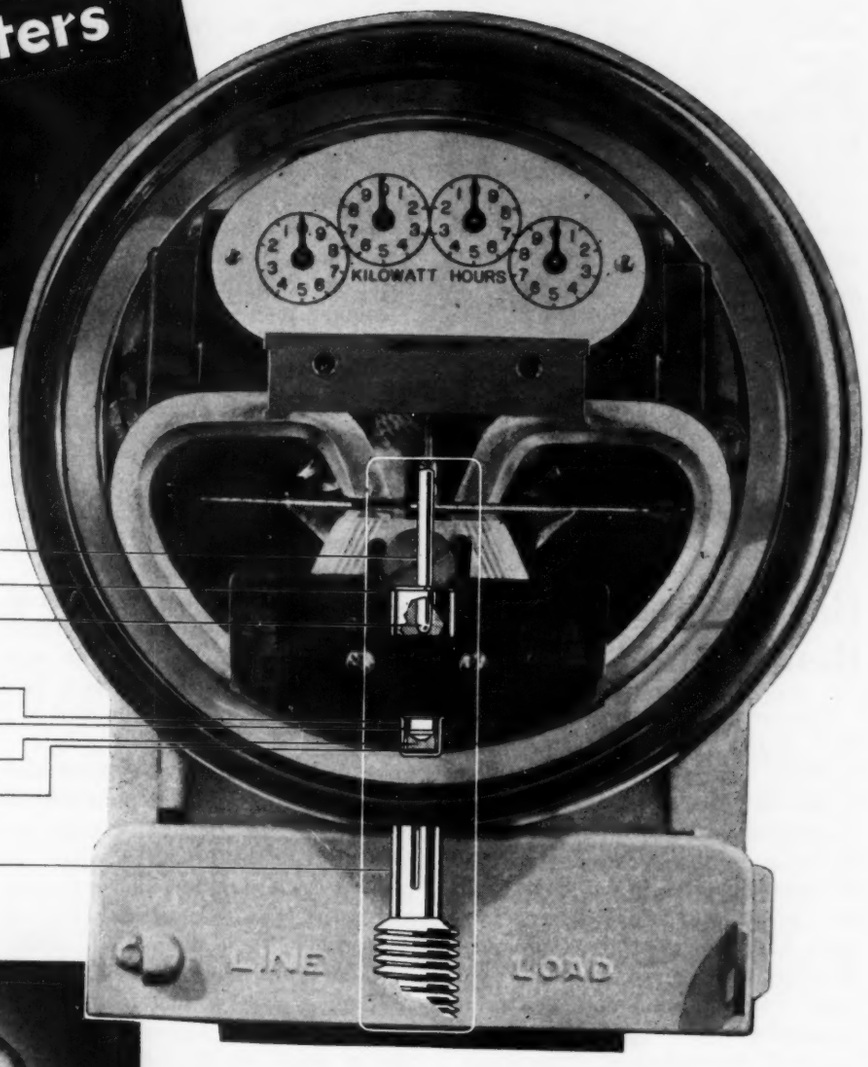
By H. R. STEVENSON
Detroit Edison Company,
Detroit, Mich.

Glue pots are found in pattern shops, furniture stores, furniture repair shops, printing shops, binderies, box factories and with the millwright of nearly every plant. Since glue must be pampered with respect to temperature, electric heat is ideal for it. Then there is solder, which is melted in many places and in quantities of ten pounds to half a ton; solder is just a bit touchy, too, for if it becomes too hot the tin content vaporizes and passes off. Type metals, as used by printing shops, are also in this class and require almost the same nicety of control. Many shops use melted paraffin or waxes in their production work, and in lesser quantiies wool fats and heavy oils.

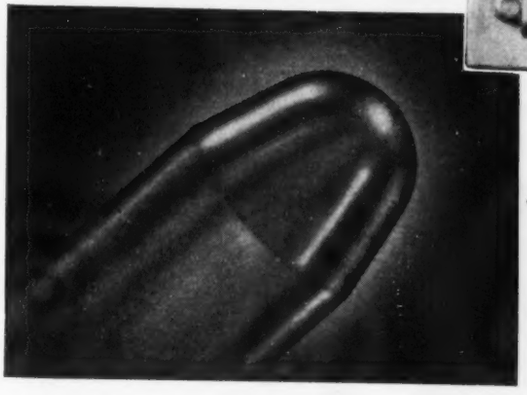
Water heating is only mentioned because so often we pass it up to look for an application not quite so prosaic, which is a very good reason why we should give it more attention. Plants working with metal stampings, or other metal parts which come in contact with oil while being produced, all use heated cleaning solutions.

Factories doing electroplating have to have heated baths, and in many such plants a large boiler is operated all summer long just to furnish

Modern Meters for Modern Loads



LOWER PIVOT ASSEMBLY
Pivot Shaft of Stainless Steel
Dust Cap, Gold Plated
Pivot of Non-Ferrous, Non-Corrodible Alloy
JEWEL ASSEMBLY
Nickeled Cup
Retaining Ring, Gold Plated
Sapphire Jewel
Paper Spacer
Lower Bearing Screw



Longer Pivot Life

Microscopic view showing bearing surface of alloy pivot used in all Sangamo alternating current meters: the pivot consists of an extremely hard, non-ferrous, acid-resisting alloy which is welded to a stainless steel shaft.

←THIS ALLOY PIVOT
a feature of L-2 single-disk, two element, A and S meters

The electrical characteristics of the recently announced Sangamo Type L-2 Meters meet all requirements for modern meter accuracy and performance. The feature of an alloy pivot and a jewel assembly, easily inspected or replaced, is incorporated in these as well as all other Sangamo alternating current meters.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

enough steam to heat these small tanks. Electric units, once installed, usually operate winter and summer in such cases. At the present time I am working on an installation where a 100-hp. boiler is operated all through the summer to heat three small tanks having a total capacity of 5,000 gal. This requires about three tons of coal a week, in addition to attendance, at an approximate monthly cost of $60. The tanks can be insulated and equipped with electric units at a cost of about $150, and the operating cost will be about $20 a month for 24-hour, 30-day use. In printing shops some sort of a drying device usually dries the wet ink on the paper as it comes off the press, and a strip heater will do a nice job here.

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Rays from New Lamp Retard Mold Growth

Scientists have known for some time that certain radiations outside the spectrum of visible light possessed germicidal characteristics, but until recently they have not been able to devise a means of producing them economically and practically. However, a low-wattage gaseous conductor lamp has been newly devised by the Westinghouse Lamp Company which now produces radiations germicidal to mold spores in air. These lamps, known by the trade name "Sterilamp," have been shown to be of considerable value in increasing the mold-free life of meats, pastry and other foods subject to storage.

Sterilamps operate on alternating current. The only auxiliary equipment required is a small transformer, from which as many as three lamps may be operated. Power taken by two lamps, plus that consumed by the transformer, amounts to less than that required for an incandescent lamp.

Annual food spoilage, which runs into millions of dollars, is largely the result of mold spores. Permeating the air of refrigerator storage rooms with germicidal rays from these lamps is said to kill mold spores and spoilage bacteria, making it possible to tenderize or age meat at higher temperatures without danger of spoilage from mold or putrefaction.

Considerable savings can be realized from this process as it greatly reduces trimming losses. The only trimming necessary when meat is aged under these radiations is removal of a dark surface film. Loss of weight is largely eliminated, since maintainance 90 per cent or higher humidity is permitted. In present commercial practices weight losses of about 30 per cent from slaughter house to table are experienced. Germicidal rays can reduce this loss to about half. Other advantages are the vast savings in refrigeration costs. Meat can be aged at 10 to 15 deg. higher temperature and in about one-third the time, thus reducing the storage space required.

In the baking industry the new lamp has been used to retard mold growth on cakes. It has been found that exposure to the rays has lengthened the mold-free life of cakes from 1½ to two days under adverse conditions. In some instances spoilage was reduced from 15 per cent to 1 or 2 per cent through use of the lamps.

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Farm Service Worth While on City System

To many operators of city properties rural service development appears more or less incidental, but experience shows that a good deal of valuable load can be picked up on the outskirts of even metropolitan areas if it is vigorously cultivated. In comparison with total new business acquired in a given period the farm load added from such territory may not appear impressive, but like many other applications of electricity it is repetitive and rapidly builds up continuing revenue. On an Eastern city property last year, for example, the rural business developed in the outlying towns totaled 272.6 kw. connected load, yielding at an average rate of about 4.3 cents per kw.-hr., $8,912 for the 207,150 kw.-hr. added. The average yearly revenue per kilowatt of connected load was $32.77 and the revenue ranged from $10.30 to $134.09. Surrounding the urban sections served by this company in 1935 were 2,124 farms which averaged 1,796 kw.-hr. consumption each last year and yielded $76.50 average revenue per farm.

Value of Rural Load Added on Outskirts of System

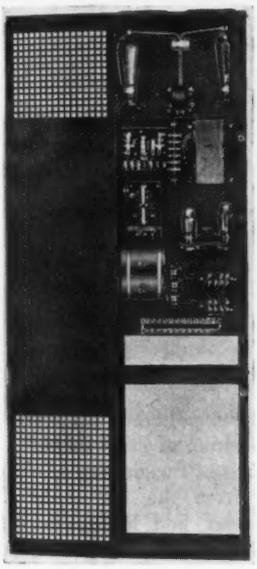
Type of Load	Connected Kw.	Annual Kw.-Hr.	Annual Revenue	Revenue per Kw. Connected
Dairy sterilizers..	21.5	15,100	$650	$30.20
Ranges.....	45.2	10,800	465	10.30
Semi-scalders	9	4,500	194	21.55
Waxers.....	4	2,000	86	21.50
Refrigerators	26.7	45,100	1,940	72.80
Lighting.....	46.2	22,000	946	20.40
Water heaters....	11	34,300	1,475	134.09
Misc.....	22.5	9,000	387	17.20
Water pumping..	10.5	5,250	226	21.50
Brooders....	15.1	13,600	585	38.70
Incubators...	7.9	12,350	531	67.50
Soil heating..	27.2	13,750	592	21.80
Poultry water warmers...	25.8	19,400	835	32.40
Totals..	272.6	207,150	$8,912	$32.77*

*Average.

Germicidal lamps cut meat-aging time

Under germicidal days 1,400 lb. of beef was aged in three or four days at this experimental installation of Beinecke Ottman Corporation, New York City. Three to five weeks was formerly required. Temperatures between 55 and 58 deg. F. and humidity of 90 to 100 per cent were maintained.

A QUICK RESPONSE ELECTRONIC ALTERNATOR VOLTAGE REGULATOR



A Ward Leonard Contribution to Power Development

An Electronic regulator that automatically maintains constant alternator voltage during the disturbing period of load changes. There is no mechanical speed of operation of the regulator for there are no moving parts. It is simple and reliable . . . needs no inspection . . . requires no more attention than does an incandescent lamp.

There are no rocking sectors or a motive system. In regulating, no circuit is opened or closed, therefore, pitting and frequent renewal of contact points is eliminated. There are no oil or air dashpots or springs requiring minute adjustment and frequent inspection . . . no complicated initial adjustments of counter weights, linkages and spring balances. There are no moving parts either light or heavy in weight . . . no bearings hence no lubrication.

This regulator requires but a half cycle to start corrective action thus minimizing voltage swings. It will not cause radio interference.

Send for descriptive Bulletins 5601 and 5601A.

Ward Leonard also manufactures Controlled Rectifiers described in the following Bulletins: No. 5701 AC to AC Constant Voltage Variable Load Regulator, No. 8601 Controlled Rectifiers for uses requiring a constant DC voltage with varying loads, No. 8602 and No. 8603 provide constant DC power from an AC source.

WARD LEONARD

ELECTRIC CONTROL DEVICES SINCE 1892

Send for Bulletins of interest

Ward Leonard Electric Company
30 South Street, Mount Vernon, N. Y.

Please send me Bulletins.....
Name .....
Firm .....
Address .....
City ..... State .....

News ABOUT PEOPLE

R. W. Davis Advanced to Assistant Managership

R. W. Davis, electrical engineer, Allis-Chalmers Manufacturing Company, has recently been appointed assistant manager of the electrical department at Milwaukee, Wis. He was graduated in 1906 from the University of South Dakota in science and mathematics, and then specialized in electrical engineering at Massachusetts Institute of Technology, receiving his degree in 1908. He entered the employ of Allis-Chalmers as a grad-

R. W. Davis

uate student apprentice, both at the Bullock and the West Allis Works, and in 1910 was moved to the electrical engineering department. From 1915 until the present time he has been actively engaged as sales engineer for the electrical department.

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▶ JACK DOUGLAS was a recent visitor to San Francisco en route to Java by way of the Philippines, Japan and China. During the past year Mr. Douglas has been in Mexico and before that in South America, where he engaged in sales activities for International General Electric Company. His work in the Orient will be for the same company.

▶ C. B. MCMANUS, assistant operating manager of the Georgia Power Company, was recently selected as chairman of the engineering and operating section of the Southeastern Electric Exchange by the board of directors. Mr. McManus soon will announce the membership of the section.

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California Edison Shifts District Managers

Personnel changes in the San Joaquin Valley territory of the Southern California Edison Company, effective September 1, have been announced by W. L. Frost, vice-president of the company.

L. R. Quinby, manager of the Delano district for the past three years, has been appointed manager of the Porterville district. He will succeed G. H. Whitney, who is to go to the Santa Ana division as power specialist. G. H. Sullivan, for the past seven years power specialist in the Santa Ana division, has been appointed manager of the Delano district, succeeding Mr. Quinby. Mr. Quinby has been with the Edison Company since 1926, joining the organization's Visalia staff. Mr. Sullivan is a former resident of the San Joaquin Valley, having been a member of the Visalia district staff from 1927 to 1929 as lighting specialist and later as power specialist.

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▶ FRED HODGE has been appointed sales manager of the Sierra Pacific Power Company, Reno, Nevada, according to announcement recently made by George A. Campbell, president. Mr. Hodge joined the utility in 1932 and has specialized in dealer contact work and promoted the cooperative merchandising program which has been successfully carried on by that company. He is a graduate of the University of California and his experience in the industry includes work with the Westinghouse Electric & Manufacturing Company, the Pacific Gas & Electric Company and Wesix Inc.

▶ G. L. KING, electrical engineer, Oklahoma Gas & Electric Company, Oklahoma City, has been transferred to the Ardmore office of that company.

Delta-Star Electric Makes New Appointments

Announcement has been made by the Delta-Star Electric Company of the appointment of Elias S. Cornell to the posi-

Elias S. Cornell

tion of chief engineer and of R. E. Anderson to the position of sales manager. Mr. Cornell received the degree of electrical engineer from the University of Zurich, Switzerland, and before joining Delta-Star in 1926 was engaged in power plant design and construction with utility companies in America. Since 1930

R. E. Anderson

he has been assistant chief engineer of Delta-Star. Mr. Anderson was graduated from the University of Michigan in 1913. He engaged in engineering work with public utilities until 1918 and after the World War joined Delta-Star.

WHAT'S THE SOCIAL SECURITY ACT GOING TO DO TO OUR ACCOUNTING, MAC ?
LET'S CALL REMINGTON RAND AND FIND OUT... THEY'VE GOT IT ALL DOWN IN BLACK AND WHITE

BEGINNING January 1, 1937, two things will happen of vital importance to every employer. First, federal taxes become payable in all states under the unemployment insurance provisions of the Social Security Act. Second, old age benefit taxes go into effect nationally.

If you are not dead certain of your own responsibilities under both these features of the Act, consider this suggestion. Remington Rand has already furnished many employers with record systems to take care of these requirements. To date records for more than a million employees have been provided.

Remington Rand invites executives to take advantage of this service without obligation. Contact the Remington Rand man in your city. Discuss with him your individual record-keeping problems. He may either suggest simple changes or complete new methods to provide the information at the lowest cost to you. The full range of equipment he has at his command permits him to advise impartially. His advice is free.

Make this note now: Phone for a man from the Systems Division of Remington Rand in your city. Or mail the coupon for full details. No obligation.

COUPON BRINGS DETAILS

Systems Division, Remington Rand Inc., Dept. 185
465 Washington Street, Buffalo, N. Y.
Please give me full details of my record-keeping requirements under the provisions of the Social Security Act.

NAME .....
COMPANY .....
ADDRESS .....
CITY ..... STATE .....

Ok.. it's from **Remington Rand**

Additions Made to Rural Staff in Illinois

Director Walter W. McLaughlin of the Illinois state Department of Agriculture has announced four staff appointments to the state Rural Electrification Commission, of which he is chairman. They are: Harry Faris, Urbana, who will handle legal research work and act in an advisory capacity on legal matters for individuals or groups of farmers; John Marquardt, Champaign, rural service engineer; W. M. Strickler, Chicago, legislative research, and H. Huebinger, Peoria, who will supervise the statewide survey of rural electrification possibilities, which Governor Horner has asked the committee to make.

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▶ LUKE P. HAYDEN, formerly district sales manager of the Bedford office of the Brooklyn Edison Company, has been appointed head of a recently organized modernization bureau. The object of this new bureau will be to effect a close co-operation and co-ordination with civic bodies, banks and contractors interested in home and commercial modernization.

▶ LLOYD W. WARNER has been appointed manager of the new-business and industrial power department of the Traction Light & Power Company, Fort Wayne, Ind. Prior to going to Fort Wayne, Mr. Warner was power sales engineer for the Southern California Edison Company. He has also served as industrial power and heating engineer for the Bureau of Power & Light at Los Angeles. He is a native of Springfield, Ill., and for a number of years was associated with public utility operating companies in Indiana.

▶ WILLIAM H. GROVE has been appointed general sales manager of the Central Arizona Light & Power Company, Phoenix. For the past several years Mr. Grove has managed the interests of the Public Utilities Consolidated Corporation. Before going to Arizona he held positions with the Brooklyn Edison Company, Republic Railway & Light Company, Cleveland Electric Illuminating Company, Public Utilities Consolidated Corporation and the Federal Light & Traction Company.

▶ W. S. CONLON, formerly engineer-manager of public works, City of Stamford, Conn., was recently appointed executive secretary of the National Society of Professional Engineers, with offices at the national headquarters of that society at Washington, D. C. Mr. Conlon was at one time connected with the Pennsylvania Power & Light Company as valuation engineer, with the Alabama Power Company and was a member of the electrical engineering staff of the firm of Murrie and Company, New York. In 1928 he became electrical engineer for Jackson and Moreland, consulting engineers of Boston and in 1929 held a similar position with the Coverdale and Colpitts Company, New York. During 1930-1932 he maintained a consulting engineering office in Stamford, Conn., until he was appointed engineer-manager of public works of that city.

▶ STUART R. WILLIAMS has been appointed manager of the street lighting department of the Holophane Company, Inc., with headquarters in Newark, Ohio. Mr. Williams brings to his new position a background of nearly fifteen years of experience in the lighting industry. In his new position he will be responsible for the promotion and sale of Holophane refractors for street lighting.

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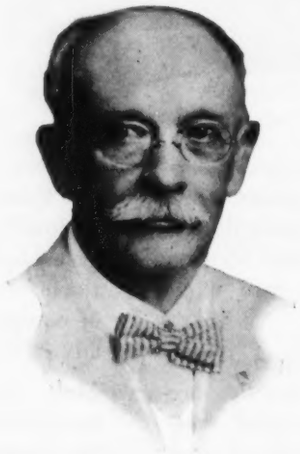
OBITUARY

Dr. Edward Weston

Dr. Edward Weston, famous scientist and engineer of international reputation, died at his home in Montclair, N. J., August 20 in his eighty-seventh year. Although best known as the founder of the science of accurate measurements, Dr. Weston had been a pioneer in many other branches of the electrical field.

Born in England in 1850, Dr. Weston came to the United States at the age of



20, entering the employ of the American Nickel Plating Company. He is responsible for many improvements in the nickel-plating art. At that time the electroplating industry was much hampered by the lack of low-voltage generators, and Dr. Weston set about to invent several new types of dynamo-electric machines, establishing in Newark in 1875 the first factory in America devoted exclusively to that class of machine. From 1875 to 1888 he engaged in intensive development of both incandescent and arc lighting, doing notable work in this field.

Relinquishing other interests, he decided to devote all his time to the development of electrical instruments and in 1888 he formed the Weston Electric Instrument Company at Newark. For seventeen years Dr. Weston was vice-president; in 1905 he became president and in later years had been chairman of the board.

A charter member of the American Institute of Electrical Engineers, he was elected president in 1888, and in 1933 he was made the recipient of the institute's Lamme Medal. He was elected an honorary memer of the Franklin Institute in 1924. He also held honorary degrees from McGill University, Stevens Institute of Technology, Princeton and the University of Pennsylvania. Dr. Weston was a philanthropist. He gave $25,000 to Stevens Institute in 1923 and in 1929 he gave another $25,000 to the American Electrochemical Society to establish a fellowship for research in electrochemistry.

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▶ HUGH H. HIGGINS, division manager of the Ohio Power Company at Portsmouth, recently succumbed to a heart attack in Akron. Mr. Higgins had started his career with the Portsmouth Street Railroad & Light Company, which was absorbed by the Ohio Power Company in 1927.

▶ STERLING G. THOMAS, for twelve years a construction engineer on the staff of the Stone & Webster Engineering Corporation, died at the Newton (Mass.) Hospital on July 27, after a short illness. He was born at Wilkes-Barre, Pa., 36 years ago and was a graduate of the Massachusetts Institute of Technology.

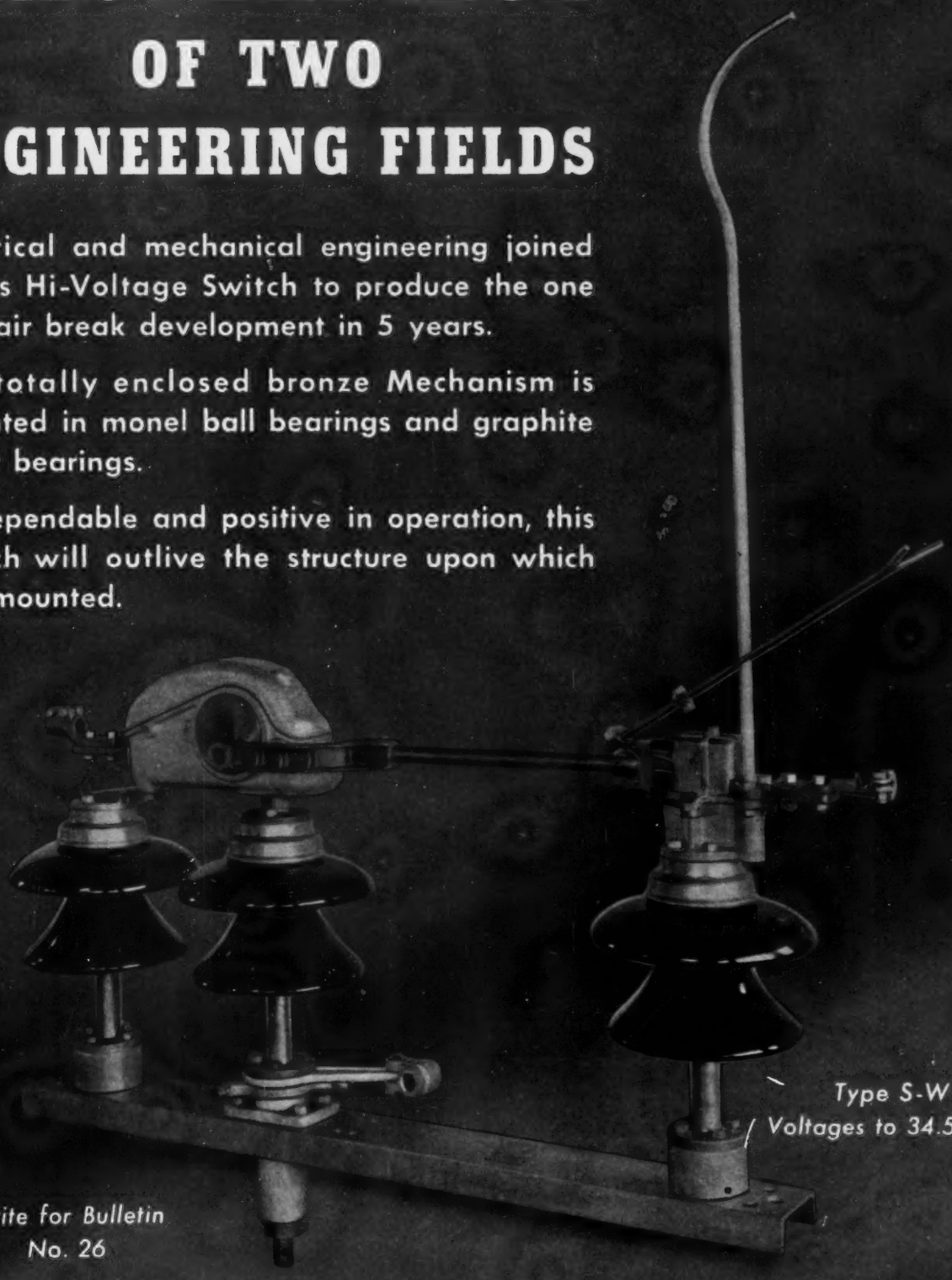
▶ HAMILTON MCRARY JONES, general manager of the International Power Company, Montreal, Que., and actively associated with the electrical industry in various parts of the world for more than thirty years, died August 12 in Montreal, after a brief illness. He was 53 years old. A graduate of the University of North Carolina in 1905, Mr. Jones joined the Westinghouse Electric & Manufacturing Company at East Pittsburgh. Subsequently he served as electrical engineer with the South Porto Rico Sugar Company and later with the Porto Rico Railway, Light & Power Company. In 1914 he returned to the United States and was sent to the Orient as a special representative of the Westinghouse company with headquarters in Tokyo. In 1921 he was sent to Mexico to open a branch office, after which he was placed in charge of the Chilean State Railway electrification work as conducted by the Westinghouse company. In 1929 he was appointed general manager of the International Power Company. Mr. Jones was a member of the American Institute of Electrical Engineers.

MASTERPIECE
OF TWO ENGINEERING FIELDS

Electrical and mechanical engineering joined in this Hi-Voltage Switch to produce the one new air break development in 5 years.

The totally enclosed bronze Mechanism is mounted in monel ball bearings and graphite insert bearings.

So dependable and positive in operation, this Switch will outlive the structure upon which it is mounted.



Type S-W
Voltages to 34.5 K. V.

Write for Bulletin
No. 26

HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH ST., CLEVELAND, OHIO

New EQUIPMENT AVAILABLE

Welding Machine

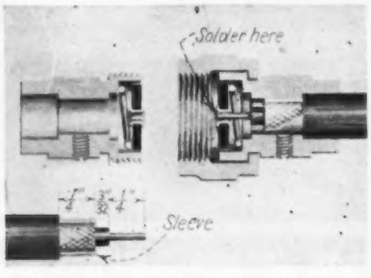
New motor-driven, single-operator type arc welders for general fabrication and repair work have been developed. It is claimed the utility of these new welders is further broadened by the fact that the machine is insulated at the proper points with Class B insulation. Since this material contains no inflammable materials, such as cotton, fiber, wood or bakelite, the insulation is protected against burnouts, and permits sustained overloads without injurious effects. Dual control of voltage and current allows independent adjustment of arc heat and penetration to suit the application. Welders occupy a floor space of less than 2 ft. square.

Model SA-150; rated current range, 45 to 200 amp.; powered by 7½-hp. a.c. motor, available for 220 and 440-volt, 60-cycle two- or three-phase circuits; stationary or portable models; weight of stationary model, 425 lb. **Lincoln Electric Co.,** Cleveland, Ohio.

•

Cable Connectors

This small, all-metal coupling unit is designed to permit instant connection or disconnection of two single-conductor shielded cables. Contact is maintained by two strong spring washers which are held under pressure when the two parts of the connector are screwed together. Manufacturers claim that failure to hold contact is a practical impossibility, thus making it suitable for use where dependability is essential, as in "microphone to amplifier" circuits. Since the diameter of the unit is slightly greater than that of the cable, it is inconspicuous in use, but it is claimed it cannot be damaged by being stepped on.



Model C-1; ⅜ in. in diameter, 1¼ in. long; accommodates cables 5/16 in. in diameter or less; finished in gunmetal. **Bruno Laboratories, Inc.,** New York, N. Y.

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Automatic Time Switches

These new time switches feature synchronous, self-starting motors, with oil-sealed internal gears, heavy silver contacts, snap-make and snap-break, and large legible dials with easily adjusted trippers. Standard models can be supplied for temperature control, poultry dimmer control, off-peak water heaters, stoker and oil heater control and for special requirements. Improper setting of trippers is said to be prevented, and the switch may be tripped manually without interfering with the set time.

"Zenith" synchronous time switch, mounted in steel case; available in 15 and 40 amp., one- and two-pole sizes; on and off and two-circuit apartment house types; hand wound, electrically wound, direct current, and astronomic dial models. **Zenith Electric Co.,** Chicago, Ill.

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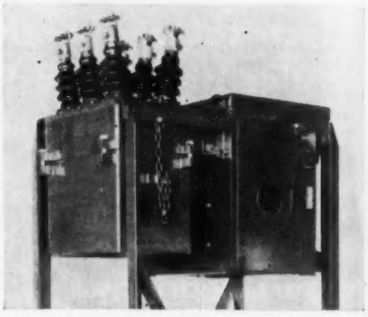
Outdoor Circuit Breaker

Designed for pole or framework mounting, an oil-blast circuit breaker, with an interrupting rating of 50,000 kva. has been announced. The breaker has a weatherproof housing with sliding doors and may be secured in double- or triple-pole models, with all poles in one tank. Silver-to-silver main contacts, butt-type arcing contacts and solderless clamp-type terminals are construction features. Manual or electrical control, the latter with a.c. or d.c., is available.



Type FKO-227; interrupting rating, 50,000 kva.; interrupting time, 8 cycles. **General Electric Co.,** Schenectady, N. Y.

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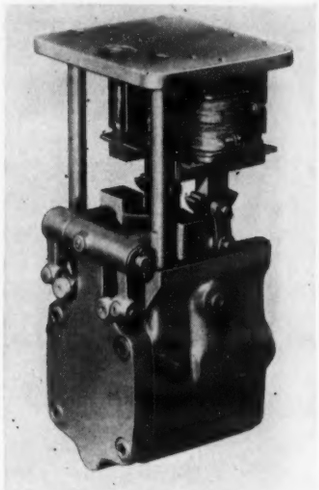
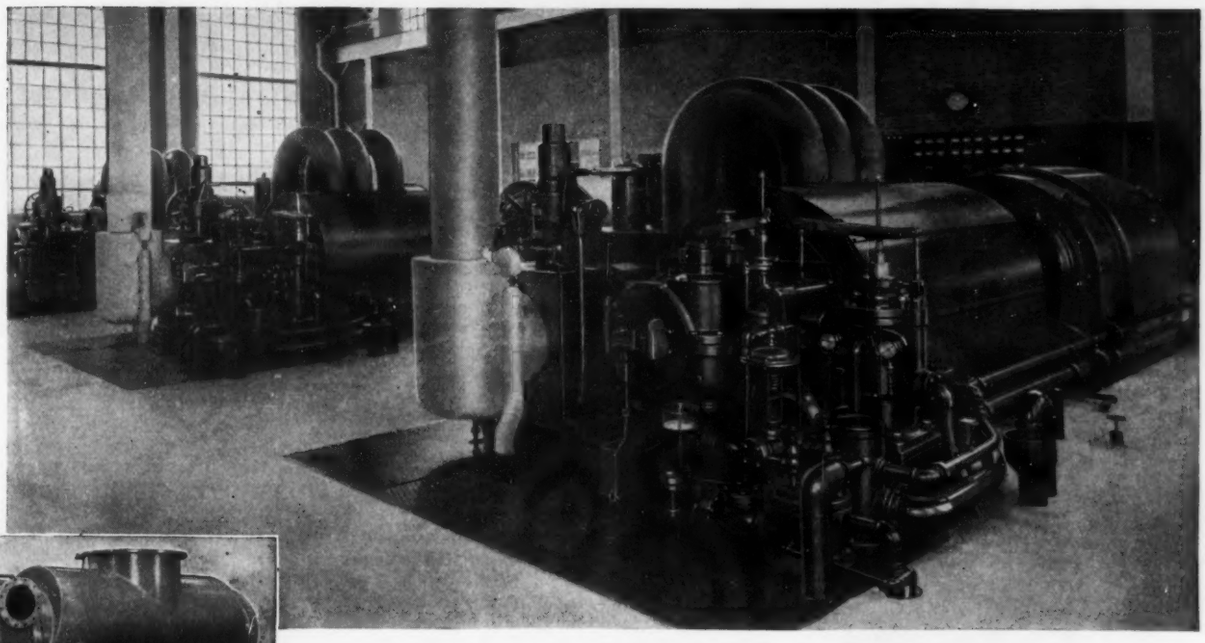
Power Feed Remote Controller

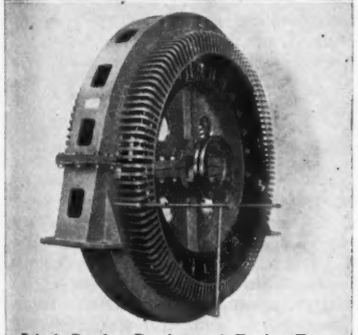
Remote controllers for fluid-power feed pumps have been announced recently. Dual solenoid operated pilot valves and a four-station control cylinder compactly built into the controller unit and flanged to the pump manifold provide positive movement of the control valve plunger. Energizing and de-energizing the two solenoids intermittently or in unison through remote push-button stations or limit switches operates the pilot valves and selects the flow of oil to the control cylinder and the function required. The combination controller piston and control valve plunger are fully enclosed.



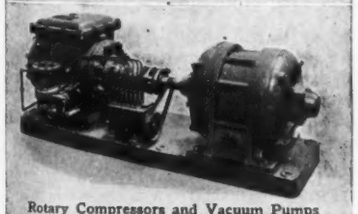
Remote controller for Oilgear feed pumps; dual solenoid types for four feed functions available in four sizes; triple solenoid types for five feed functions may also be secured. **Oilgear Co.,** Milwaukee, Wis.



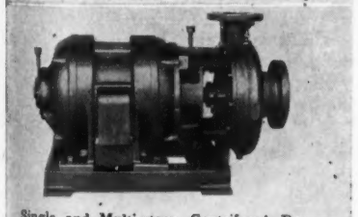
Surface and Jet Condensers



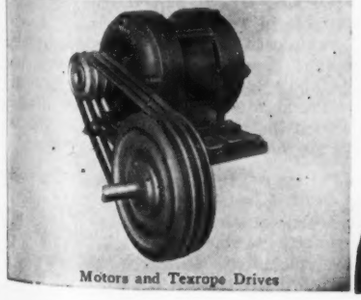
Belted, Bracket Bearing and Engine Type Synchronous Motors and Generators



Rotary Compressors and Vacuum Pumps



Single and Multi-stage Centrifugal Pumps



Motors and Texrope Drives

Steam and Power

... *Balanced for Best Economy*

INDUSTRIAL PLANTS using low pressure steam for process or heating require careful balance between load and steam demands together with coordination of the equipment involved in order to operate most efficiently. Properly selected steam turbines and their auxiliary equipment can accomplish this balance. The turbine will furnish the power and process steam or utilize excess low pressure steam.

Allis-Chalmers offers experience and cooperation in working out heat balance problems with steam turbine units. In many cases existing units can be modified to meet present day problems.

From the Allis-Chalmers line of single and multi-stage impulse, combination impulse-reaction and all reaction type turbines we can furnish a turbine suited to particular requirements for either mechanical drives or turbine-generator units, large or small.

Not only does Allis-Chalmers build a complete line of steam turbine units but also complete electrical equipment including generators of all types, voltage regulators, automatic synchronizers, metal-clad switchgear, switchboards, and transformers; also motors for every kind of service and every type of drive.

Other power plant equipment includes Corliss engines; steam condensers; condensate, circulating, boiler feed and general purpose pumps; compressors and dry vacuum pumps; Texrope multiple V-Belt drives, etc.

A coordination of this equipment will give you a balanced plant. When modernizing your plant it will pay to get in touch with Allis-Chalmers engineers; offices are located in all principal cities.

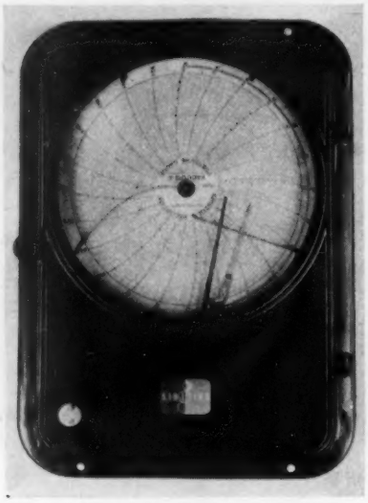
ALLIS-CHALMERS

— Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, U.S.A. —

THE NEW YORK CLIPPER April 15, 1871

Pressure Controllers

Announcement has been made of a series of low-range recording gages and controllers for draft or pressure, small enough to be carried under the arm. These instruments are equipped with inclosed bell-type measuring elements and a special sensitive adjustment for synchronizing throttling area with process lag. The large operating area of the liquid-sealed bell is said to make the measuring element respond instantaneously.



Model D4OM series; in 12-in. cases; minimum ranges, 0 to 0.2 in. of water; maximum ranges, 0 to 2.0 in. of water. **Bristol Co.**, Waterbury, Conn.

•

Out-of-Step Relay

Out-of-step relay; mounted in 5½x16-in. case; capacitor and resistor for notching device mounted externally. **General Electric Co.**, Schenectady, N. Y.

A new relay has been announced which is designed to prevent continued operation of synchronous machines out of synchronism with their connected system, or to function to separate large interconnected systems at a specific location in the event of an out-of-step or unstable condition between the sources of power on both sides of this location. This relay consists of an instantaneous overcurrent unit, a single-phase, power-directional unit, an auxiliary unit to increase the operating speed, a notching device and a time-delay element for resetting the notching device.

Sensitive Analyzer

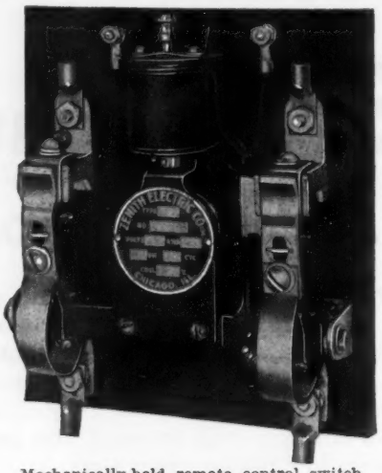
Weston analyzer; 50-microamp. instrument; four resistance ranges, top range gives deflection to 30 megohms, separate jacks for low current ranges. **Weston Electrical Instrument Corp.**, Newark, N. J.

Sensitivity of 20,000 ohms per volt is claimed for this new analyzer which is said to meet present requirements for analyzing radio receivers and electronic equipment. High resistance values above 1 megohm, on the top range, are said to be sufficiently spaced out to permit an accurate check on all resistors in common use; this characteristic is also of value in d.c. leakage tests of condensers. Rapid changes of range and function for a.c. and d.c. measurements is permitted by a convenient system of pinjacks and a rotary switch.

•

Remote-Control Switches

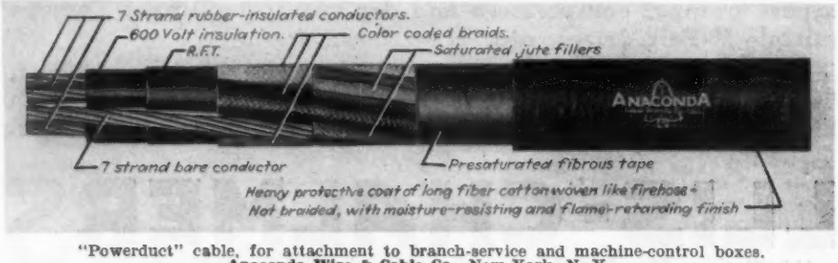
Developed for indoor installations, where the a.c. hum of electrically held switches may be annoying, a series of mechanically held remote-control switches are available. They are designed for use with time switches or push buttons to operate large loads. Two coils are used, one for closing the switch, the other for opening. Coils are energized only momentarily during closing and opening, no current being consumed when the switch is in either position, according to the manufacturer's claim.



Mechanically-held remote control switch, 75 amp., two poles; dimensions, 7x8x4 in.; available also in 30 to 300 amp., two- and three-pole sizes. **Zenith Electric Co.**, Chicago, Ill.

Flexible Industrial Cable

Flexibility and durability are claimed for this new cable, particularly when used for connection to equipment that may have to be relocated. Three rubber-insulated (600 volts) conductors and one bare ground conductor are cabled with saturated jute fillers, bound together by presaturated tape. Over this assembly is a heavy protective coat of long-fiber cotton, woven like a fire hose—not braided. The outer covering is saturated and finished with moisture resisting and flame retarding compounds. Each conductor consists of seven strands of tinned soft-annealed wire. It is said that the cable will resist deterioration by oil, grease and gasoline, and will withstand mechanical abuse.



"Powerduct" cable, for attachment to branch-service and machine-control boxes. **Anaconda Wire & Cable Co.**, New York, N. Y.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

GENERATOR PROTECTION—Bulletin 1134 of the I-T-E Circuit Breaker Company, Philadelphia, Pa., discusses in 8 pages the methods of connecting circuit breakers for the protection of d.c. generators, two and three wire, operated singly or in parallel. The discussion is accompanied by schematic wiring diagrams showing the correct connections.

POWER TRANSMISSION EQUIPMENT — Announcement is made by Link-Belt Company, Chicago, of a new 208-page catalog, No. 1500, devoted exclusively to power transmission equipment. The new book features the recently announced line of Link-Belt antifriction roller bearing units, as well as an entirely new group of babbitted bearings, several new types of take-ups and many other new products.

METERS AND TIME SWITCHES—Operation of combination watt-hour meters and time switches is explained in General Electric bulletin GEA-2312 A. Construction features are illustrated and wiring diagrams of the meter circuit are included.

SOLDERING LUGS AND SPLICING SLEEVES—Wolverine Trade Bulletin, Form 528, published by Wolverine Tube Company, 1411 Central Avenue, Detroit, Mich., lists complete specifications, dimensions, ratings and weights for this line of copper soldering lugs and splicing sleeves.

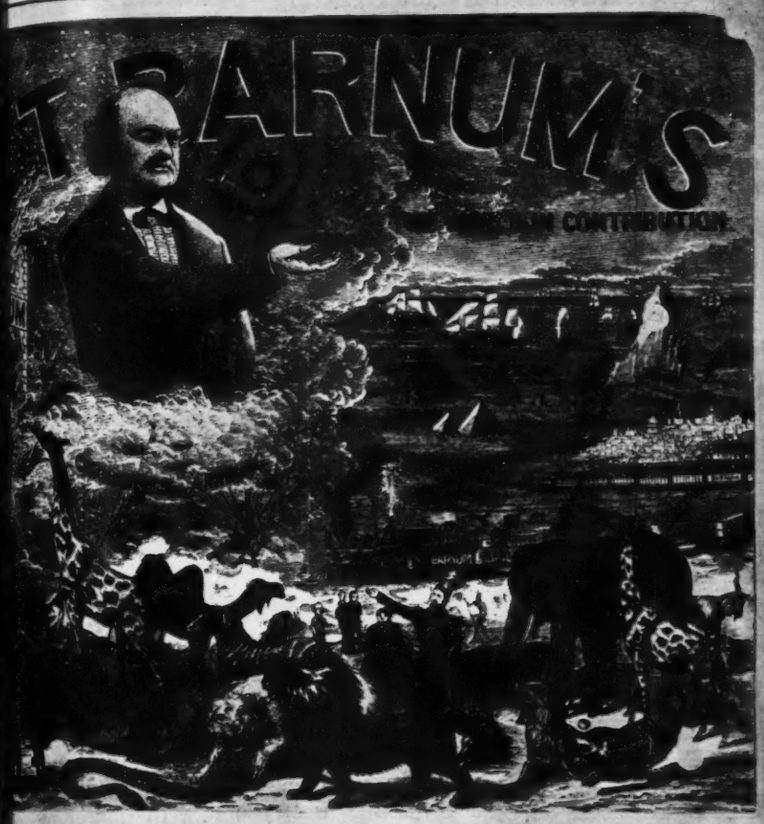
ELECTRIC CONTROLS—New a.c. and d.c. manual and automatic motor controls are included in the industrial catalog recently issued by Ward-Leonard Electric Company, Mount Vernon, N. Y. Mechanical features, dimensions, ratings of field rheostats, d.c. and a.c. starters, manual and automatic regulators, contactors, and automatic transfer switches are also presented in the list of electrical controlling devices.

MERCURY VAPOR LAMP—Technical data on a new 85-watt, high-intensity, mercury-vapor lamp is given in Sales Engineering Notes No. 130, issued by Westinghouse Lamp Company, Bloomfield, N. J. Operating characteristics and construction features of the lamp are also described in the 2-page bulletin.

FRACTIONAL-HORSEPOWER MOTORS — What size fractional-horsepower motor is best suited for air conditioners, oil burners, refrigerators? The answer may be found in "Why Ohio Motors Are Reliable," a bulletin of the Ohio Electric Manufacturing Company, Cleveland, Ohio. Operations in the manufacturing of these motors are also pictured and described.

BOLTS, NUTS, SCREWS, WASHERS—H. M. Harper & Company, 2620 Fletcher St., Chicago, Ill., have issued a catalog of their line of bolts, nuts, screws and washers. These are available in brass, copper, bronze, Monel metal, stainless steel and other materials. Pictures of these items, sizes, dimensions, weights, and a table showing the comparative chemical and mechanical properties of the metals used in their manufacture are also in the 48-page booklet.

OVEN SAFETY DEVICE—Designed for use on gas-fired industrial heaters, a new safety device which automatically lights them and also protects against pilot-light failure is described in bulletin 457 of the Bristol Company, Waterbury, Conn.



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To the Public.

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in this country, or ever organized as a traveling exhibi-
tion on this continent.
CHALLENGE No. 12.
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Barnum would have lost

IF HE HAD LIVED TODAY!

• Back in the spring of '78, P. T. Barnum, the wizard of the show business, offered $1,500,000 in challenges to the public—one of the biggest displays of showmanship, one of the biggest gambles in salesmanship that any man has ever made. The very size of the challenges frightened away any would-be takers and drew customers like the well known sheep to the fold, but—

Barnum would have lost if he had lived today.

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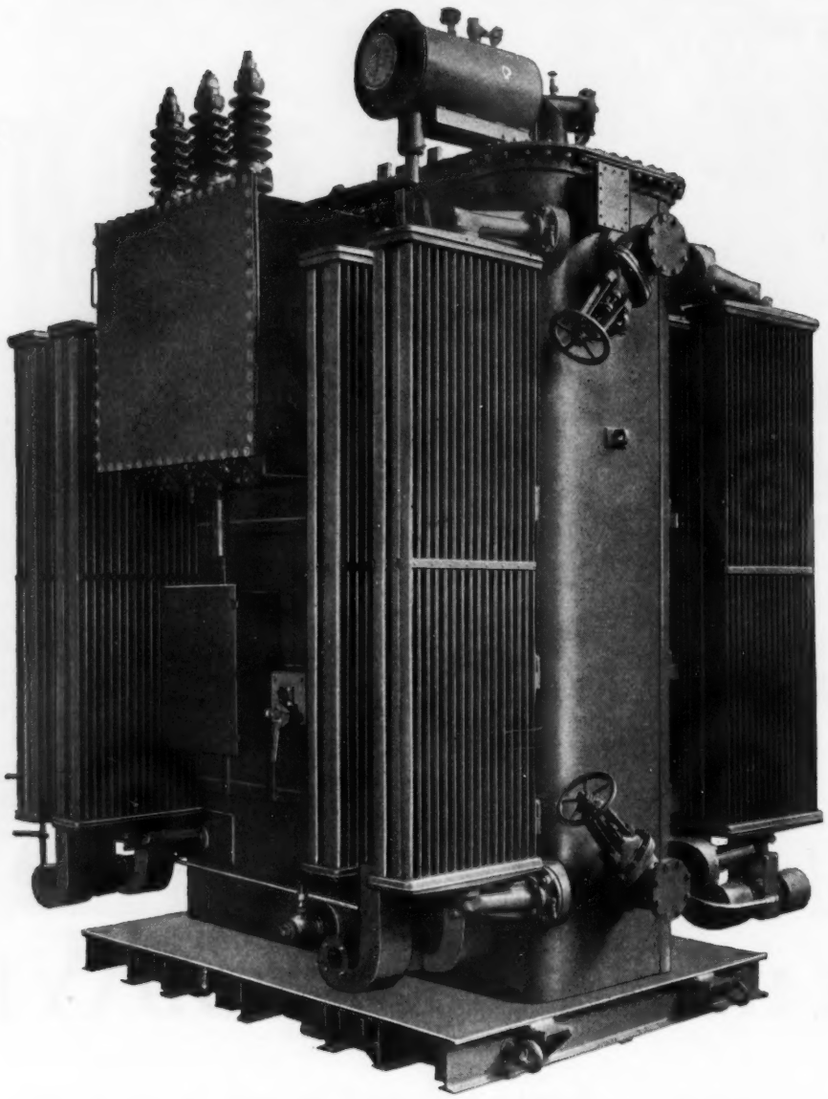
POWER TRANSFORMERS



The Wagner plant is fully equipped to build single- or three-phase power transformers in standard sizes and voltages. The transformer here illustrated is a 12,000-kva, 34,500-volt delta to 4500-volt Y, three-phase air-blast power transformer fully equipped with the latest relay and control devices.

Write today for the new Wagner Bulletin 181 which completely describes Wagner power transformers.

Wagner Electric Corporation

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TP236-1B

TRANSFORMERS *MOTORS* *FANS* *BRAKES*

Consolidated Edison System

[*Continued from page 58*]

exhausting into 200-lb. steam mains. The generator will be hydrogen cooled. Steam for this unit will be supplied by two single-drum, straight-tube boilers, each having a capacity of 500,000 lb. per hour at a pressure of 1,400 lb. The furnaces will be completely water cooled and fired with pulverized coal through tangentially set burners. Arrangements will be made for continuous slag removal. Present plans call for the installation of three more of these high-pressure units with their boilers and one low-pressure unit of 50,000-kw. capacity.

Load factor and performance

The load factor of the system for the year 1935 based on the half-hour net maximum load was 48 per cent, although that of the generating stations was only 42.5 per cent, which is lower than the system figure due to the high load factor of the power received from the Niagara Hudson System.

B.t.u. performance of the stations varies with the conditions under which they are operated, the best station at the present time having a B.t.u. rate based on net kilowatt-hour output of approximately 13,300 B.t.u.'s, the entire system rate being approximately 15,800 B.t.u. on the same basis.

•

Electrical Chiefs Remain in Barcelona

After the foreign population of Barcelona had been evacuated by British warships four Englishmen were left in the war-ravaged Spanish city. Three of these men decided to remain to carry on the essential electrical services.

These men are Royston St. Noble and George St. Noble, brothers, who control the Anglo-Espanola de Electricidad, and Mr. Lawton, managing director of the Barcelona Traction, Light & Power Company, the Canadian company which supplies most of Barcelona with light and power and operates a suburban electric railroad. All three have spent most of their lives in Barcelona and talk Spanish like natives.

To guarantee the safety of these three men the government committee in Barcelona has provided them with temporary residence in the Club Maritima, overlooking the harbor, where they are in the shadow of the British warships sent there to protect foreign interests.

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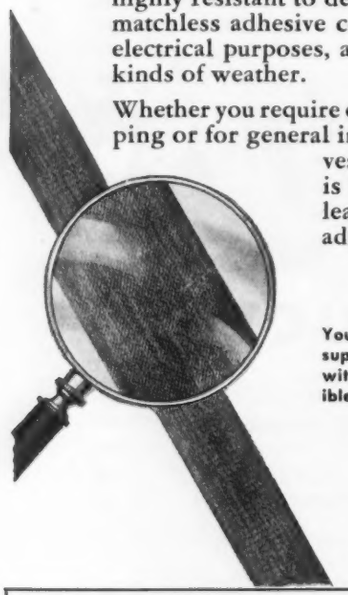
Whether you require electrical tape for coil or cable wrapping or for general insulating uses, it will pay you to investigate this outstanding tape which is backed by more than 50 years of leadership in the field of industrial adhesives.



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Municipal Plants

FAIRFIELD, ALA.—Ordinance calling for a special election September 21 to decide as to whether the city shall acquire, own and operate a municipal light and power system has been introduced before City Council. The ordinance was offered by Carl C. Gates, Alderman, who explained a proposed line would be tied in with those of Bessemer, for which P.W.A. funds have been allocated, and which at the present time are tied up in an injunction suit in the United States Supreme Court.

SACRAMENTO, CALIF.—Pacific Gas & Electric Company has filed a petition in the federal court for an injunction to halt the sale of $12,000,000 of bonds by the Sacramento Municipal Utility District. The company charged the district's plan to create a competing power system is "palpably unreasonable, arbitrary, confiscatory and oppressive and manifestly and unreasonably discriminatory under the facts and circumstances." A temporary restraining order and preliminary injunction, pending final hearing of the action, are sought. Unsuccessful in its fight in the state courts, the power company now turns to the federal courts.

RICHMOND, IND.—Approximately ten thousand consumers of energy generated by the municipal electric light plant have been granted a rate reduction totaling $50,000 a year. Last October consumers received a reduction representing $37,000 annual savings. The October reduction stimulated consumption and brought about operating economies which resulted in the new reduction. Earnings for 1936 will be at least $475,000, an increase of $74,000 over 1935. The new reductions affect virtually all consumers, ranging from 9 per cent for domestic customers to 15 per cent for commercial users and 22 per cent for rural users.

ELKHART, IND.—Committee of the City Council in a report recommended that the city establish its own electric generating plant to supply energy for street lighting, city buildings and probably for school buildings. The report recommends that such a plant could be established in the city waterworks pumping station. A saving of more than $12,000 a year could be effected by such a plant, the report stated.

BOONE, IOWA—City has granted the Iowa Electric Light and Power Company a renewal of its franchise by a vote of 2,202 to 492.

GLENCOE, MINN.—Preparations are going forward to recount votes cast July 28 on the question of whether city should build a municipal power plant. The vote was 617 favoring the municipal plant, as compared with 412 against the issue, but a dispute has arisen whether 60 per cent or a plain majority is required for passage. On the basis of a 60 per cent margin the 617 count is 2/5 of one vote short. Meanwhile the Northern States Power Company has obtained a temporary restraining order from Judge C. M. Tifft after contending that the "yes" vote lacked 60 per cent margin, questioning the legality of the election and contending further the council is without legal power to incur debts in behalf of the city to erect the plant.

CINCINNATI, OHIO—Estimated costs of four types of municipal electric systems, varying from $1,750,000 to $45,000,000, depending on their purposes, were included in a recent report by Edgar Dow Gilman, Cincinnati Public Utilities Director. A plant

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Get started on your Fall Lighting Activity Plans. Send for this complete campaign plan today. It is available to utility executives without charge or obligation! Also the complete Mitchell Catalog, with a splendid group of I.E.S. Lamps for your regular merchandising.

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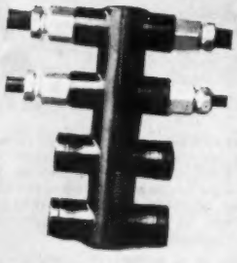

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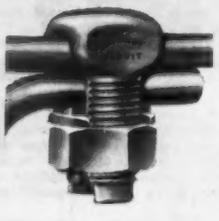

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capable of serving all municipal needs and needs of Cincinnati's metropolitan area would cost between $40,000,000 and $45,000,000, according to Mr. Gilman. Other types of municipal systems discussed provide for only partial service, allowing the private utility to serve what the city does not. An ordinance has been introduced by City Councilman Herbert Bigelow to submit to voters at the November election the question of providing $50,000 for a municipal light plant survey and for determing the advisability of obtaining T.V.A. power.

COLUMBIA, TENN.—A special election will be held September 1 to pass on a proposed $300,000 bond issue for a municipal light and power plant and distribution system.

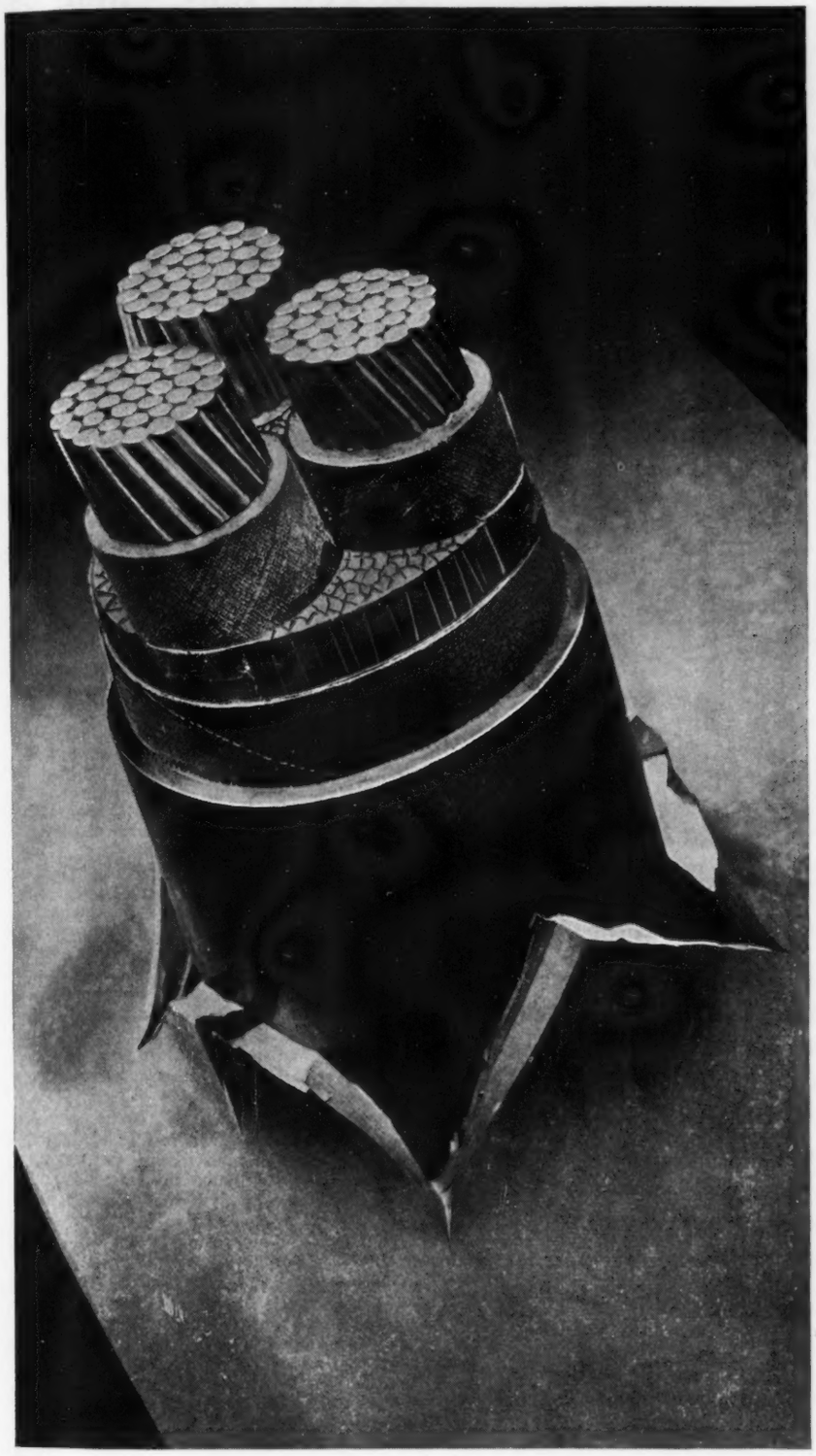
TEMPLE, TEX.—City Commission is considering a proposal to call an election to vote on issuing bonds for the construction of a municipal electric light and power plant. John W. Carpenter, president of Texas Power & Light Company, which is serving the city, has requested the commission not to call the election until he can submit a statement in regard to the city's claim for $44,000 of overcharges against the company.

CHEWELAH, WASH.—In a decision handed down by Superior Judge Clay Allen, Stevens County was upheld in its battle with the Washington Water Power Company, which attempted to invalidate the county system established recently under the Bone power bill. The company asked that the commissioners be restrained from engaging in the public utility business on the ground that it conflicts with the municipal utility in the town of Chewelah. The company sells power to Chewelah, which maintains its own distribution system. It also distributes water in the town and contention was made that a county set-up would afford unwarranted competition. Judge Allen found, however, that Chewelah does not completely meet the water needs of the district and held that the county utility was valid.

JEFFERSON COUNTY, WIS.—A temporary injunction restraining the Wisconsin Public Service Commission from enforcing its order requiring the Wisconsin Gas & Electric Company to extend its electric lines into the towns of Oakland and Sumner, Jefferson County, has been granted by Circuit Judge A. C. Hoppmann. The injunction will stand pending disposition of the suit of the company for a permanent injunction. The utility seeks to void the commission's order on the ground that the towns are in territory of the Wisconsin Power & Light Company under a contract entered into several years ago.

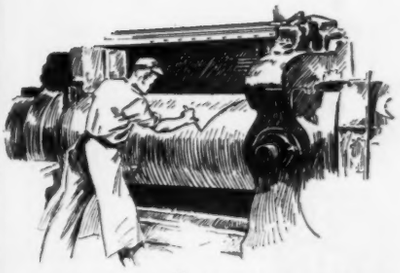
LODI, WIS.—Voluntary reduction of $2,221 in electric rates at the municipal plant, effective September 1, has been approved by the Wisconsin Public Service Commission.

BROOKLYN, WIS.—Final order in the village's acquisition case has been made by the Wisconsin Public Service Commission when it gave the village 60 days to pay into Dane County circuit court the full price of $10,644 fixed on the electric plant of the Wisconsin Power & Light Company. The village has already paid $10,000 into court through the sale of bonds and must now pay the additional $644 to cover additions to the plant made since the commission fixed the original order price in 1934. Court appeal delayed the acquisition until recently. The commission in the Brooklyn case laid down the principle and successfully defended it in the state supreme court, that a municipality served by a system utility need pay only the price of the local plant and not any severance damages in an acquisition proceeding.



ROEBLING

Rubber Insulated Cables



Sketch of our 84" Rubber Sheeting Mill, one of the many modern operations in the making of Roebling Rubber Insulated Cable.

Shown is only one of the Roebling Line of rubber Insulated Wires and Cables. They are made in a variety of insulated compounds to exactly meet a wide range of requirements such as, power transmission, railway signalling, building wiring and many other purposes.

Plain Rubber 60% Sheath Power Cable. "SAFECOTE" Rubber-insulated and Braided Wires and Cables: Code, Intermediate, 30% and 40% Performance, 35% and 40% Performite. 40% and 60% Sheath Flexible Cords. Parkway, Service, Mining, Welding, and Control Cables; Tree Wire.

These will give you a fair idea of the completeness of the Roebling Line. They are made in a wide range of sizes and voltages. Armors:—steel, zinc, or bronze tape, or round steel wire.

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YOU can't select the best transformer from a photograph, but pictures of AmerTran transformers do indicate good workmanship, rugged construction, attractive appearance and careful attention to details. Equal care has been exercised in the design and construction of concealed parts. Coils are wound on laminated, kraft-paper tubes; are provided with ample oil ducts; are vacuum impregnated in varnish. Core laminations of highest quality, non-ageing silicon steel are cut, assembled and clamped so as to have low losses and good mechanical strength. Syphon-proof bushings are of the coordinated type. Transformers are shipped filled with oil of the best grade obtainable.

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Recent Rate Changes

TOLEDO CITY COUNCIL repealed legislation granting the Toledo Edison Company a new power rate contract for three years one day after its enactment. City officials stated they had learned that the saving under the new contract would be only 3 per cent instead of the 15 per cent officials thought they were getting, since the company had filed a new rate June 25 with the Ohio Public Utilities Commission granting similar reductions to users of large amounts of power. City Manager John Edy charged the company broke faith with the city by keeping silent on the June 25 rate during the negotiations. Council had voted a three-year contract instead of the usual five and had ordered study of a proposal covering the installation of a city-owned power plant.

SAN ANTONIO PUBLIC SERVICE COMPANY has notified the city commission that it will make reductions in its electric and gas rates to consumers aggregating approximately $415,000 annually, as demanded by the city, if the company's franchise, expiring in 1940, is extended twenty years. The company proposed to reduce domestic electric rates in higher brackets 12½ per cent; commercial and industrial power rates 10 per cent, and domestic gas rates 5 per cent. The city's application for P.W.A. assistance when funds are available to establish a municipal power plant had been approved.

NEW YORK PUBLIC SERVICE COMMISSION heard last week objections filed by twenty-eight public utility companies to assessments made by the commission in connection with the costs of proceedings held in May. The assessments, which totaled about $59,000, were routine and were levied under the provisions of statutes enacted as part of Governor Lehman's public utility reform program. They were imposed in connection with rate hearings before the commission. W. T. Wilkinson, examiner of the commission's staff, will submit his report to the commission, after which the companies will have thirty days within which to reimburse that body. Among the utilities represented at the hearing were the companies of the New York Edison system, Long Island Lighting Company, the Orange and Rockland Electric Company and a group of up-State corporations.

WESTCHESTER LIGHTING COMPANY has been ordered by the New York Public Service Commission to reduce electric rates approximately $716,000 by September 1. This is in addition to reductions of $1,200,000 made effective June last year. The company is now directed to advance to September 1 the effective date of certain "inducement" rates and to make them applicable to all classes of consumers irrespective of previous consumption. The rates were filed by the company last year and made available only to those who increased their consumption after June 1, 1935. Under this arrangement the "inducement" rates were not to apply to all customers until January 1, 1938. Residential consumers will save $503,000 a year because of application of the "inducement" rate to them. Commercial and other genreal users will save $209,000 a year.

YONKERS ELECTRIC LIGHT & POWER COMPANY has been ordered by the New York Public Service Commission to reduce its electric rates approximately $132,000 annually. Of that total residential customers will save $52,000 and commercial consumers $67,000. A suspension order for a large-use rate previously filed by the company is lifted by the commission, permitting the rate to go into effect, with resulting savings of about $12,000 to large users.

WISCONSIN PUBLIC SERVICE COMMISSION

Sturtevant

REG. U. S. PAT. OFF.

. . . THE MECHANICAL DRAFT FANS SELECTED FOR

World's Record Plants

1 THE WORLD'S LARGEST POWER PLANT!

HUDSON AVE. STATION, BROOKLYN EDISON CO. 47 Sturtevant Patented Vane Controlled Fans . . . with capacity of 22 million pounds of gas and air per hour . . . serve this plant, which has the largest installation of mechanical draft fans in the world.

2 THE WORLD'S CHAMPION STEAM PRODUCER!

EAST RIVER STATION, NEW YORK EDISON COMPANY. 33 Sturtevant Draft Fans driven by Sturtevant Steam Turbines. Total capacity: 13,514,500 lbs. of air and gas per hour. 1,250,000 pounds of steam per hour produced by each boiler equipped with Sturtevant fans . . . a world's record!

3 THE WORLD'S LARGEST BOILER!

LOGAN, WEST VIRGINIA PLANT, AMERICAN GAS & ELECTRIC CO. New boiler will have capacity of 1,000,000 lbs. of steam per hour. Sturtevant Patented Vane Controlled Forced and Induced Draft Fans were chosen for this boiler, the induced fans operating at a tip speed of over 4 miles per minute!

4 THE WORLD'S LARGEST TURBO-GENERATOR!

STATE LINE STATION, CHICAGO DISTRICT ELECTRIC GENERATING CORP. 24 Sturtevant Patented Vane Controlled Fans serve the largest turbo-generating unit ever built . . . 208,000 kilowatts capacity.

And for hundreds of other Stations including . . .

Edison Electric Illuminating Co. of Boston (Edgar)
Milwaukee Electric Railway & Light Co. (Port Washington)
United Electric Light and Power Co. (Hell Gate)
Cleveland Electric Illuminating Co. (Ashtabula and Avon)
Pacific Gas and Electric Co. (Station A.)
Lynn Gas and Electric Co.
Ohio Power Co. (Philo)
Alabama Power Co. (New Gorgas)
Deepwater Operating Co. (Deepwater)
Appalachian Power Co. (Cabin Creek and Logan)
New Jersey Power and Light Co. (Gilbert)
Puget Sound Power and Light Co. (Shuffleton)
West Virginia Pulp and Paper Co. (Luke and Covington)
Public Service Electric and Gas Co. of N.J. (Burlington)
United Illuminating Co., Bridgeport, Conn.
Union Electric Light and Power Co. of Cincinnati
Monongahela West Penn Public Service Co.
Commonwealth Edison Co.
West Penn Power Co.

B. F. STURTEVANT COMPANY, Hyde Park, BOSTON, MASS.

Branch Offices in 40 Other Cities

B. F. Sturtevant Co. of Canada, Ltd.—Galt, Toronto, Montreal

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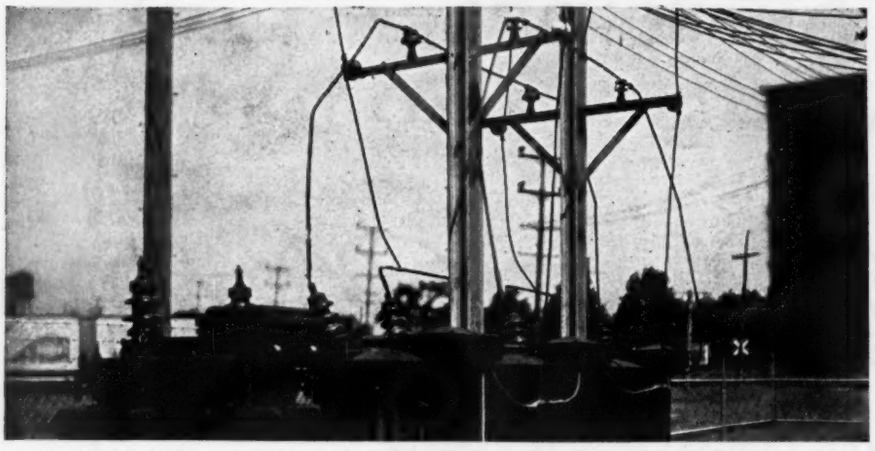
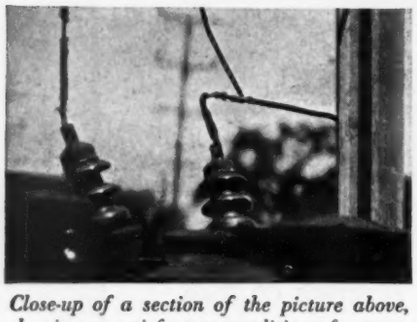
Puts Air to Work

DRAFT FANS · TURBINES · GEARS · ECONOMIZERS · AIR HEATERS

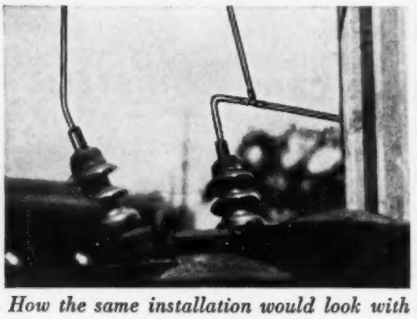
SEE FOR YOURSELF



A typical light-duty substation, with the "loose" wiring commonly used for this kind of installation. Notice the "raggedness" of appearance, the non-rigid character of the bus construction.



Close-up of a section of the picture above, showing unsatisfactory condition of connections from use of wire.



How the same installation would look with Chase Round Copper Tube. Neat, rigid, easy to install, easy to change.

...why CHASE Round Copper Tube is better for substation buses

A new development for light-duty substation buses is Chase "Thin-Wall" Copper Tube and Fittings. Actually costing but little more than the usual wire bus construction, it has the outstanding advantages of rigidity, long service life, and efficient use of substation structures. Both tube and fittings are light in weight, easy to install, easy to change and maintain design clearances.

For heavier-duty service, Chase Copper Tube is available in standard and extra-heavy I. P. S. sizes. For these, likewise, a complete line of fittings is provided.

Refer your special conductor problems to our engineers, who will furnish complete engineering information on applications and installations of Chase products.

CHASE

MAIL THIS COUPON
for your *free* copy of our 40-page engineering handbook, complete with technical information, tabular data and engineering specifications.

Chase Brass & Copper Co., Incorporated*
Dept. E-3, Waterbury, Connecticut

Please send me a copy of your publication, "Chase Copper Tube for Bus Construction."

Name .....

Title ..... *Company* .....

Address .....

City ..... *State* .....

*Subsidiary of Kennecott Copper Corporation

at the suggestion of the Lake Superior District Power Company has approved a $4,745 rate reduction for 1,820 store and office customers of the company. On the application of the utility for authority to erect a $200,000 reservoir dam across the west branch of the Montreal River to improve power production at Saxon Falls and Superior Falls, the commission set a hearing in Hurley on September 9.

FLORIDA POWER CORPORATION has reached an agreement with Tallahassee city officials on new electric rates for a twelve-year period beginning January 1. The terms must be ratified in a city referendum. Eight years ago the city shut down its own generators and agreed to purchase electric power from the company under a ten-year contract, which expires in 1938. City Clerk Bridges said the proposed new contract would save the city approximately $250,000 in the twelve years.

KINGSPORT UTILITIES, INC., operating in upper east Tennessee has announced a reduction in rates which will save commercial and domestic customers $23,000. The new rates approved by the Railroad and Public Utilities Commission become effective September 1.

NEW YORK PUBLIC SERVICE COMMISSION has announced that it had directed electric utility companies of New York City to file a new rate for "breakdown" or emergency service to become effective October 1. The rate is for emergency service to private lighting plants. Milo R. Maltbie, the commission chairman, held it would be reasonable for the utilities to file rate schedules for breakdown service containing a demand charge of $30 a kilowatt a year, payable monthly. He held, too, that the rate shall not exceed the rate submitted last year, which was a block rate, the first block consisting of 1,000 kw.-hrs. and carrying the rate of 5 cents a kilowatt-hour, and the lowest block covering energy supplied in excess of 150,00 kw.-hr. a month at the rate of 0.8 cents a kilowatt-hour.

BALTIMORE COUNTY COMMISSIONERS, who have filed complaint with the Maryland Public Service Commission charging that the cost of lighting the streets and roads in the county is excessive, have appointed John D. Hamilton, engineer, to make an investigation of the entire subject. The action was taken in anticipation of a hearing before the commission. The Consolidated Gas, Electric Light & Power Company of Baltimore which supplies the lighting facilities in the county, has filed an answer to the complaint denying the charges made.

WISCONSIN PUBLIC SERVICE CORPORATION and its sister company, Menominee & Marinette Light & Traction Company, have been ordered by the state Public Service Commission to reduce factory, farm and office rates $58,000 a year. The reduction is in addition to rate decreases of $228,375 a year which were either ordered or negotiated in the general investigation of the two utilities which the commission has just completed.

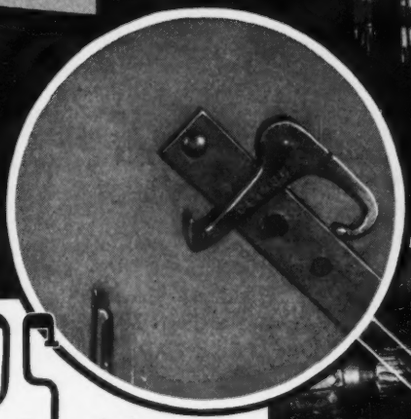
•

Associated Eliminates Two More Subsidiary Companies

Associated Gas & Electric System has eliminated two more companies in its program of simplification of its corporate structure. The two companies eliminated are Shenandoah Pulp Company and Management Holding Corporation. The first was dissolved and the second was merged with Associated Utilities Corporation.

•HI-PRESSURE CONTACTS characterize all R&IE switching equipment•

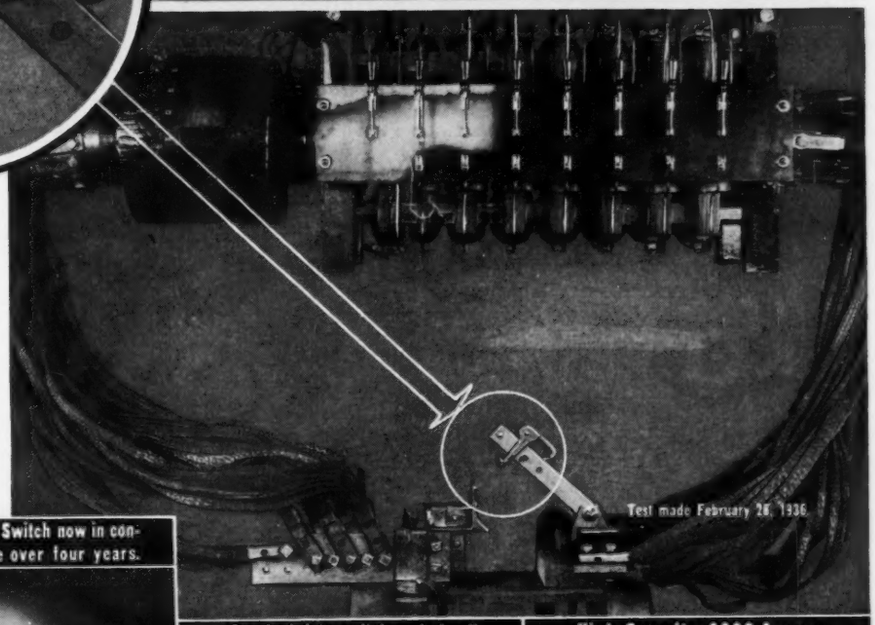
FOR THE GENERATING STATION



Type HPS proves "SPOT CONTACT" reliability •

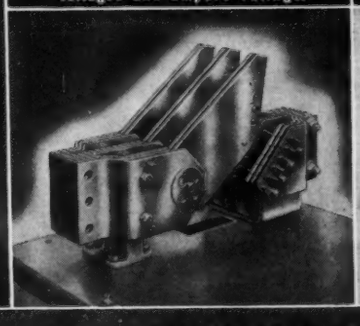
In the test shown at right an overload current of 7760 amperes passed through a single spot contact of a standard 400 ampere switch for 10 seconds .... the other spot contact being insulated. Result .... no welding, buckling or burning, proving that "Contact resistance is a function of pressure and not of surface."

Each operation of the blade wipes contact surfaces clean.

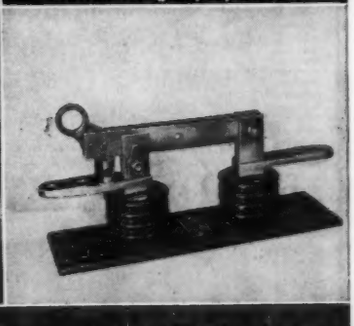


3000 Ampere Switch now in continuous service over four years.

Standard duty switch made in all voltages and ampere ratings.



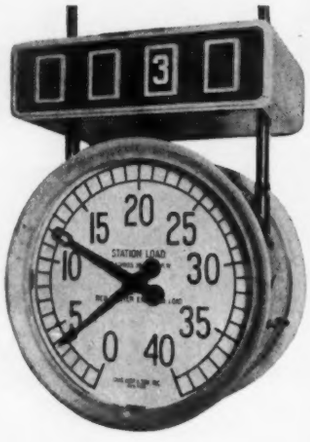
High Capacity, 6000 Ampere Switch for group operation.



RAILWAY AND INDUSTRIAL ENGINEERING CO.... GREENSBURG, PA.

HI-PRESSURE CONTACTS •• AN ORIGINAL R&I E FEATURE

CORY
SIGNAL SYSTEMS
For the Power Plant



CORY CENTRAL STATION LOAD INDICATING SYSTEMS are used in the modern power plant as a means for indicating at various points throughout the station, such as the boiler room, turbine room, control room or load dispatcher's office, the load carried by the station. Combination Systems for the indicating of future load requirements at predetermined intervals, in addition to the present station load, are also available.

CORY TURBINE ORDER SYSTEMS are used in central stations for the transmission of routine signals from the control room to the turbine room or vice versa. Means for automatically energizing the system while in use, as well as for sounding an audible alarm signal to accompany the transmitted signal, are standard Cory features. Transmitted signals may be checked by means of a reply pointer and signalling may originate from either point. Master transmitting instruments can be supplied, wherein the common transmitter may be used to signal one of a number of receiving stations.

THESE and many other signal systems of special types have been developed and are available for every signal requirement.

BENDIX MARINE PRODUCTS CO., Inc.

754 Lexington Avenue, Brooklyn, N. Y.

A Subsidiary of

BENDIX AVIATION CORP.

South Bend, Ind.

Educational Awards by General Electric

Educational loans totaling $4,700 have been made to 24 employees or sons of employees from the Gerard Swope Fund for Union College at Schenectady and the General Electric Educational Loan Fund. In addition, two Charles P. Steinmetz scholarships to Union College have also been awarded.

Loans from the two funds are made to employees or sons of employees with sufficiently high scholastic standing to justify them. Steinmetz scholarships are awarded to students planning to enter Union College whose marks are above the average. Loans and scholarships are granted annually and are passed on by the education committee of the company.

•

Sodium Lighting Aids Traffic Conditions

In order to facilitate the movement of automotive traffic in a locality where severe fogs are prevalent, the Washington Department of Highways last fall installed a sodium lighting system on a section of the Pacific highway extending south of Tacoma for 2.9 miles to Lakeview. Sixty-six units, using 10,000-lumen sodium lamps developed by General Electric engineers, are in operation.

L. V. Murrow, director of highways for Washington, in commenting recently on the installation, said: "The construction of this experimental section of highway lighting was made primarily to relieve the conditions experienced by the heavy fogs encountered along this section of highway. And the results which have been obtained prove conclusively that the lights are not only effective in fog but are extremely beneficial and helpful for night driving under ordinary conditions."

•

Dry Goods Men Form Electrical Appliance Group

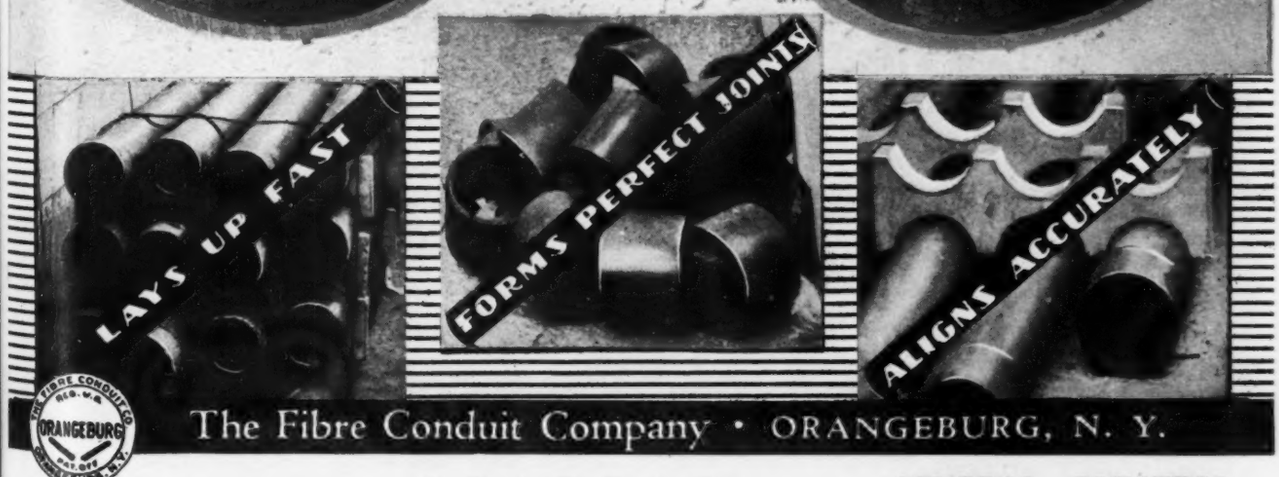
A major electrical appliance group of the National Retail Dry Goods Association was organized during the recent Housewares Show held in New York. Edward List, appliance manager Abraham & Straus, Brooklyn, N. Y., was made chairman of this group.

Problems of mutual interest to both retailers and manufactures will be considered by the new organization, which, it is hoped, will enlist the co-operation of managers of electrical appliance departments with a view of promoting more profitable operation.

ORANGEBURG FIBRE CONDUIT — *time-tested in 43 years' service*

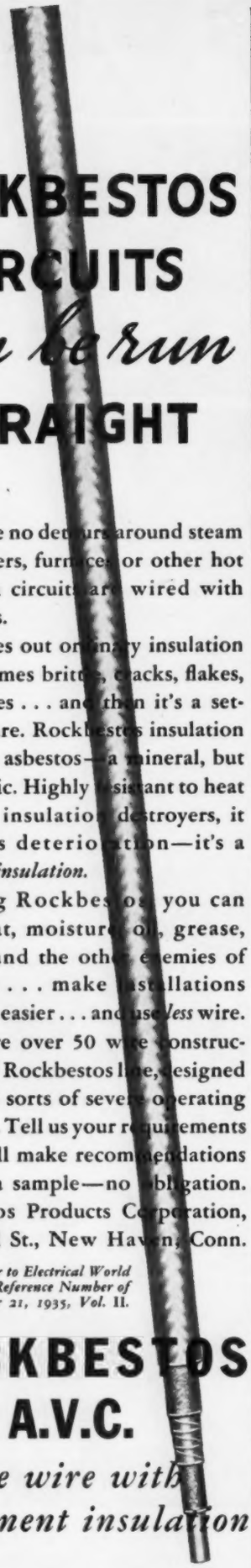
Built for the ultimate savings from perfect service . . . . . your installation costs reflect the immediate economy of

ORANGEBURG



The Fibre Conduit Company • ORANGEBURG, N. Y.

SALES AGENTS: **GRAYBAR ELECTRIC COMPANY** • **GENERAL ELECTRIC SUPPLY CORPORATION**



ROCKBESTOS CIRCUITS *can be run* STRAIGHT

There are no detours around steam pipes, boilers, furnaces or other hot spots when circuits are wired with Rockbestos.

Heat dries out ordinary insulation . . . it becomes brittle, cracks, flakes, disintegrates . . . and then it's a set-up for failure. Rockbestos insulation is basically asbestos—a mineral, but non-metallic. Highly resistant to heat and other insulation destroyers, it withstands deterioration—it's a *permanent insulation.*

By using Rockbestos you can forget heat, moisture, oil, grease, vibration and the other enemies of insulation . . . make installations simple and easier . . . and use *less* wire.

There are over 50 wire constructions in the Rockbestos line, designed to meet all sorts of severe operating conditions. Tell us your requirements and we will make recommendations and send a sample—no obligation. Rockbestos Products Corporation, 826 Nicoll St., New Haven, Conn.

Also refer to Electrical World Buyer's Reference Number of December 21, 1935, Vol. II.

ROCKBESTOS A.V.C.

the wire with permanent insulation

SALES OPPORTUNITIES IN NEW CONSTRUCTION

COUNCIL BLUFFS, IOWA — Citizens Light & Power Company plans extensions in transmission lines for rural electrification, including service facilities. Application has been made for permission.

WASHINGTON, D. C.—General Purchasing Officer, Panama Canal, Washington, receives bids until September 10 for main propelling machinery and auxiliary equipment for Diesel-electric tug, "U. S. Gatun" (Schedule 3173).

CLARKE, ALA. — Washington County Power Association, Inc., Clarke, recently organized, receives bids until September 1 through Rural Electrification Authority of Alabama, Birmingham, for construction of about 51 miles of transmission and distributing lines for rural electrification in part of Washington County. Fund of $65,000 has been secured through Federal aid. Power will be furnished by Alabama Power Company.

CLEVELAND, OHIO—Murray Ohio Manufacturing Company, 1115 East 152nd Street, plans installation of motors and controls, electric hoists, conveyors and other equipment in new two-story addition to metal products plant. Cost over $100,000. George S. Rider Company, Marshall Building, is architect.

LOS ANGELES, CALIF. — Purchasing agent, Los Angeles Water and Power Bureau, 207 South Broadway, receives bids until September 10 for transformers, distribution and small power type, in such quantities as required for period of one year (Specification No. 2054).

GRUNDY CENTER, IOWA — Grundy County Rural Electric Association, Grundy Center, recently organized, plans transmission and distributing lines for rural electrification in part of Grundy County, totaling 235 miles, with service facilities. Cost close to $240,000. Financing is being arranged through Federal aid.

NEWARK, N. J.—City Commission plans installation of new traffic lights at number of street intersections. Cost about $50,000. Financing is being arranged through Federal aid.

PROVINCETOWN, MASS. — Provincetown Power & Light Company has approved plans for extensions in power plant, with installation of additional equipment. G. F. Clements, Hyannis, Mass., is architect.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, receives bids until September 8 for one 160-kv. oil circuit breaker for switchyard at Wilson dam power station, and for four 115-kv. oil circuit breakers for switchyard at Norris dam power plant.

HOQUIAM, WASH.—Grays Harbor Pulp & Paper Company plans installation of motors and controls, regulators, electric pumping machinery and other equipment for expansion and improvements in sulphite pulp mill. Cost about $175,000. W. S. Lucey is general manager.

TECUMSEH, NEB.—Eastern Nebraska Public Power District, recently organized. George W. Kline, 403 Liberty Theater Building, Lincoln, Neb., secretary, receives bids until September 2 for construction of about 380 miles of transmission and distributing lines for rural electrification in parts of Johnson, Nemaha, Otoe, Pawnee and Richardson Counties, including main substations and farm substations. Initial fund of $250,000 has been arranged through Federal aid. Henningson Engineering Company, Union State Bank Building, Omaha, Neb., is consulting engineer.

TUCUMCARI, N. M.—United States Engineer Office, Tucumcari, receives bids until September 10 for construction of main dam and wing dams, Conchas Dam Project, South Canadian River, vicinity of Newkirk, N. M., including one 150-kw. hydroelectric power unit, one 75-kw. gasoline-electric unit, power and lighting system, operating house and other facilities.

FLINT, MICH.—Palace Travel Coach Corporation plans installation of motors and controls, electric hoists, conveyors for expansion in automobile trailer works. Company has acquired existing industrial building on Hemphill Road, 60,000 square feet of floor space, and will remodel and equip for works. Cost about $100,000. Tract of about 20 acres of adjoining land has been purchased for proposed addition in 1937, to cost close to like sum.

ORD, NEB.—North Loup Hydro-Electric & Irrigation District, C. O. Sorenson, Lincoln, Neb., attorney and representative, has authorized plans for hydroelectric power plant near Sioux Creek, vicinity of Ord, with power dam 400 feet long and 40 feet high, including diversion dam on North Loup River, near Burwell, canals and other structures. Cost about $2,000,000, including transmission lines and power substation units. Financing has been arranged through Federal aid. Project has been approved by Government and bids are scheduled to be asked in near future. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

WAPAKONETA, OHIO—Plans early call for bids for city-owned electric power plant. Funds of $150,000 is being arranged through Federal aid. Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

FORT MONMOUTH, N. J.—Property Officer, United States Signal Corps Laboratories, Fort Monmouth, receives bids until September 14 for three switchboards (Proposal 1).

ORLANDO, FLA.—Florida Public Service Company plans extensions in 33,000 volt transmission lines to phosphate district, with substation facilities in latter area for industrial power supply. New transmission and distributing lines also are planned for rural electrification in a number of districts, totaling over 50 miles, with service facilities.

LAUREL, MISS.—Masonite Corporation plans installation of motors and controls, conveyors and other equipment in new experimental plant for wallboard and allied material manufacture. Fund of $200,000 has been authorized for new unit, with an additional appropriation of $150,000 for expansion and improvements in present plant. Main offices of company are at 111 West Washington Street, Chicago, Ill.

COLUMBUS, NEB.—Loup River Public Power District, 2307 Thirteenth Street, Columbus, Harold Kramer, secretary, will take bids soon for transmission line for connection between power plants at Columbus and Monroe, Neb. Harza Engineering Company, 20 North Wacker Drive, Chicago, Ill., is consulting engineer.

TACOMA, WASH.—Port Commission, F. H. Margin, president, plans installation of motors and controls, conveyors, electric lighting and signal systems and other equipment in new addition to Port of Tacoma bulk grain elevator on waterfront. Fund of $146,450 has been secured through Federal aid for entire project. G. W. Osgood is manager, in charge.

FAYETTE, MISS.—Fayette-Utica Rural Electrification Association, now being organized, care of Mississippi State Electrification Authority, Jackson, Miss., Evon Ford, chairman, plans transmission and distribution lines for rural electrification in vicinity of Fayette and Utica, Miss., totaling about 125 miles, with power substation and service facilities. Fund of approximately $150,000 will be arranged through Federal aid.